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Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

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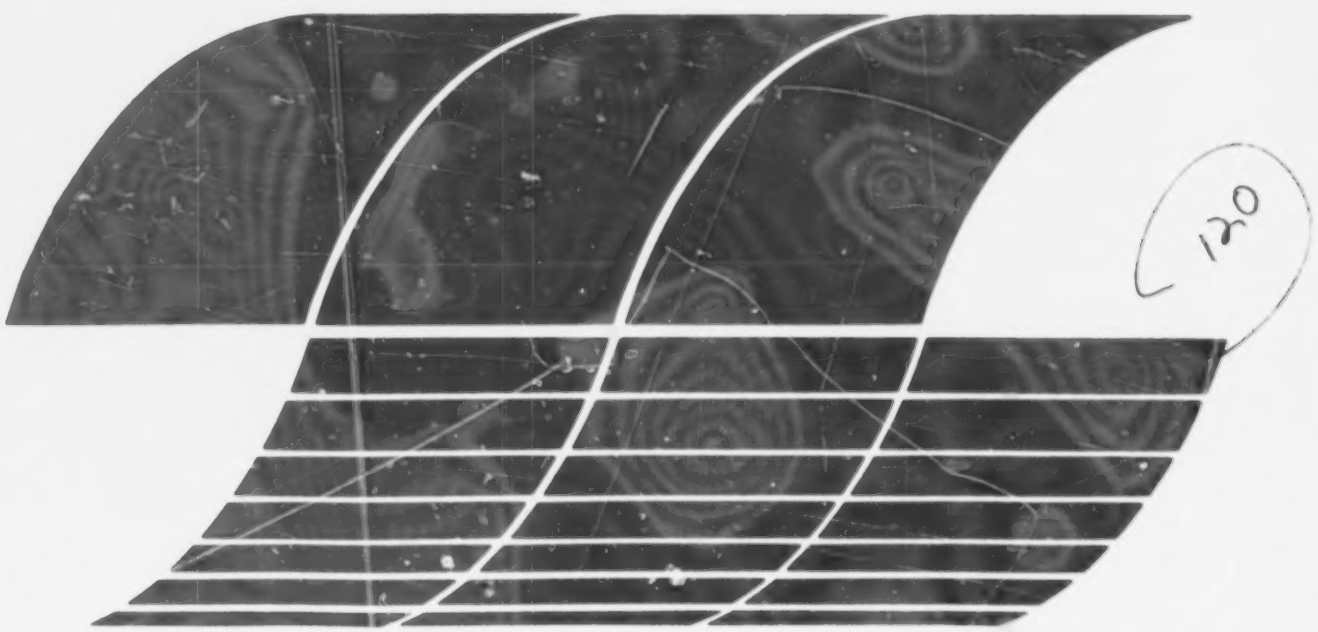
Reactor Test Project for Chemical Removal of Pyritic Sulfur from Coal; Volume II. Appendices

COMPLETED

Interagency Energy/Environment R&D Program Report

ORIGINAL



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Reactor Test Project for Chemical Removal of Pyritic Sulfur from Coal; Volume II. Appendices

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ABSTRACT

Plant checkout and shakedown was completed at the end of September and initial plant process performance was evaluated on an Appalachian coal. Operation of the plant through January of 1978 demonstrated that the Reactor Test Unit (RTU) could be run continuously in three-shift operation to reduce the coal from 2.4 lbs $SO_2/10^6$ Btu to a level of 1.0 to 1.2 lbs $SO_2/10^6$ Btu, after rinsing and extraction of generated elemental sulfur. There was no measurable coal oxidation during processing and leach rates in the plant were greatly improved over bench-scale values. The leach solution/coal/oxygen environment was found to be corrosive to the installed stainless steel reactor, necessitating future upgrading to support additional testing. Bench-scale experimentation showed that the leach solution can be used as a homogeneous dense-media to efficiently gravity-separate coal prior to processing. Beneficial engineering cost improvements are obtained based on using this approach, resulting in capital cost estimates of $68-$69/KW and with $0.44-$0.50/10^6 Btu processing costs, including amortization of capital, for input coal costing $0.78-$0.81/10^6 Btu. Overall energy efficiency was 93 to 96 percent.

APPENDIX A. COMPUTER PROGRAMS UTILIZED DURING RTU DATA REDUCTION

```
      PROGRAM DORIC(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE3,TAPE4
     1             ,TAPE5)
C       WRITTEN 7/14/77  DEBBIE HOBB  247360  REVISED 8/5/77, 10/5/77
C       REVISED 11/8/77 (NEW TIME FORMAT)
C       READS DORIC DATALOGGER TAPE, CHANGES 11DIGIT CHANNEL WORD TO 10,
C       MAKES NEW TAPE AND PREPARES LISTING
       COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
      1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
      2         IFIL,IMAX,NMAX,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
      3         PT172,PT150,TE173,TE148
       INTEGER ALARM,SIGN,POWERF,OK,SYMBOL,DORIN,DOROUT,BLANK
       DATA SYMBOL/1R>,1R<,1R),1R(,1H*,1R ,1R-,1RS/,
      1     ALMPRT/10HHIGH      ,10HLOW       ,10HHIGHER    ,
      2            10HLOWER     ,10HOVER RANGE,10H          ,
      3            10H          /,ITARG/2,4/,DENS/1.24/,
      4     IMAX/113/,NMAX/102/,IALCH/48/,BLANK/10HSSSSSSSSSS/,OK/1R /
       DATA UNITS/10HVOLTS     ,10HDEG F     ,10HDEG F     ,10HDEG F
      1,    10HDEG F     ,10HDEG F     ,10HDEG F     ,10HDEG F     ,
      2     10HDEG F     ,10HDEG F     ,10HDEG F     ,10HDEG F     ,
      3     10HDEG F     ,10HDEG F     ,10HGALLONS   ,10HSCFH      ,
      4     10HSCFH      ,10HPERCENT   ,10HPERCENT   ,10HPOUNDS    ,
      5     10HPOUNDS/HR ,10HPSIG      ,10HPSIG      ,10HPSIG      ,
      6     10*10HGPM       ,10HINCHES    ,10HINCHES    ,10HPSIG      ,
      7     10HPSIG      ,10HPSIA      ,10HPSIA      ,10HVOLTS     ,
      8     8*10HDEG F     ,41*1H ,10HPSIG      ,10HINCHES    ,7*1H ,
      9     10HMV        /
       DATA (PARAM(I),I=1,66)
      1/11HSELF CHECK ,15HT-2 CELL 1 TEMP,15HT-2 CELL 2 TEMP,
      1     15HT-2 CELL 3 TEMP,15HR-1 CELL 1 TEMP,15HR-1 CELL 2 TEMP,
      2     15HR-1 CELL 3 TEMP,15HR-1 CELL 4 TEMP,15HR-1 CELL 5 TEMP,
     318HOXYGEN TEMP TO R-1,18HV-1 DISCH GAS TEMP,18HLEACH TO V-1 TEMP ,
     419HLEACH FROM V-1 TEMP,11HR-2 TEMP    ,19HR-1 DISCHARGE TOTAL,
     518HOXYGEN FLOW TO R-1,18HV-1 DISCH GAS FLOW,18HO2 ANAL REFERENCE ,
     615HO2 ANAL SAMPLE ,15HAUTOWEIGH TOTAL,15HAUTOWEIGH RATE ,
     715HR-1 PRESSURE   ,15HOXYGEN TO R-1  ,19HV-1 DISCH GAS PRESS,
     818HP-1 DISCHARGE FLOW,18HP-2 DISCHARGE FLOW,18HP-3 DISCHARGE FLOW,
     918HP-4 DISCHARGE FLOW,18HP-5 DISCHARGE FLOW,18HP-6 DISCHARGE FLOW,
     1014HT-3 LEACH FLOW,19HP-9 DISCHARGE FLOW,19HP-10 DISCHARGE FLOW/
       DATA (PARAM(I),I=67,200)/
     118HP-7 DISCHARGE FLOW,16HT-2 SLURRY LEVEL,16HR-1 SLURRY LEVEL,
     220HPUMP P-1 DISCH PRESS,16HN2 SUPPLY TO R-1,16HS-1 VACUUM PAN A,
     316HS-1 VACUUM PAN B,19HRAMAPO EX. MONITOR,20HLEACH SL TEMP TO T-3,
```

Appendix A-1. Computer Program for Converting Doric Magnetic Tapes to an Engineering Format.

```
     413HT-4 TANK TEMP,13HV-1 TANK TEMP,15HT-4 H2O IN TEMP,
     519HT-10 FLUSH H2O TEMP,14HP-1 DISCH TEMP,20HS1 INLET TEMP SLURRY,
     6 16HT-4 H2O OUT TEMP,12*1H ,
     315HP-16 FLOW ALARM,15HN2 TO T-1       ,15HFEED TANK T-1  ,
     416HA.W. DELIVERY HI,16HA.W. DELIVERY LO,12HT-2 HIGH LVL,
     511HT-2 LO LVL ,13HR-1 HI HI LVL,11HR-1 HI LVL ,11HR-1 LO LVL ,
     613HR-1 LO LO LVL,15HR-1 HI PRESSURE,18HR-1 MIX MOTORS OFF,
     718HV-1 TANK LO LVL    ,18HT-5 HI LVL         ,18HT-4 HI LVL         ,
     818HK-1 VACUUM OFF     ,18HOXY SUPPLY LO LVL ,18HINST. AIR LO LVL  ,
     919HSTEAM SUPPLY LO LVL,15HN2 PURGE LO LVL,18HN2 MANIFOLD LO LVL,
     118HT-10 WATER LO LVL ,18HT-6 HI LVL         ,18HR-2 HI LO LVL      ,
     220*1H ,20HPUMP P-7 DISCH PRESS,16HR-2 LIQUID LEVEL,14*1H ,
     319HXDUCER P.S. MONITOR/
      DATA TAG/8HUJR-170 ,8HTE-19    ,8HTE-20    ,8HTE-21    ,8HTE-52    ,
     18HTE-53    ,8HTE-54    ,8HTE-55    ,8HTE-56    ,8HTE-173   ,8HTE-148   ,
     28HTE-199   ,8HTE-200   ,8HTE-99    ,8HFE-60    ,8HFE-61    ,8HFE-44    ,
     38HAE-171   ,8HAE-171   ,8HWT-9     ,8HWT-9A    ,8HPT-173   ,8HPT-172   ,
     48HPT-150   ,8HFE-29    ,8HFE-83    ,8HFE-84    ,8HFE-85    ,8HFE-86    ,
     58HFE-87    ,8HFE-31    ,8HFE-157   ,8HFE-158   ,8HFE-101   ,8HPT-26    ,
     68HPT-58    ,8HPT-28    ,8HPT-307   ,8HPT-249   ,8HPT-250   ,8H          ,
     78HTE-32    ,8HTE-201   ,8HTE-202   ,8HTE-203   ,8HTE-195   ,8HTE-28    ,
     88HTE-      ,8HTE-204   ,6*1H ,
     98HFSL-237 ,8HPSL-181 ,8HLSL-8    ,8HWSH-9    ,8HWSL-9    ,8HLSH-26   ,
     98HLSL-26  ,8HLSHH-58 ,8HLSHL-58A,8HLSHL-58B,8HLSL-59   ,8HPSH-151 ,
     18HM4 TO M8,8HLSL-37  ,8HLSH-88   ,8HLSH-91   ,8H         ,8HPSL-163 ,
     26HPSL-164 ,8HPSL-165 ,8HPSL-168 ,8HPSL-169 ,8HLSL-175 ,8HLSH-120 ,
     38HLSHL-95 ,10*1H ,9HPT-100   ,8HPT-95    ,8*1H /
C
      REWIND 3
      REWIND 4
      REWIND 5
      WRITE(5,1000)
 1000 FORMAT(1H1)
      IFIL=1
  110 LIST(I,IFIL)=0
  115 DO 120 I=1,IMAX
  120 DORIN(I)=BLANK
  125 READ(3) DORIN
      IF(EOF,3) 190,130
  130 LIST(1,IFIL)=LIST(1,IFIL)+1
C     STORE HEADER, DATE AND TIME
      DOROUT(1)=DORIN(1)
```

Appendix A-1. (Continued)

```
C     CHANGE METHOD OF STORING TT # FOR CTS15
      KSTORE=LBYT(37,18,DORIN(2))
      CALL SBYT(43,18,DOROUT(2),KSTORE)
C     MOVE POWER FAIL BETW. DAY & HR
      KSTORE=LBYT(19,6,DORIN(2))
      CALL SBYT(37,6,DOROUT(2),KSTORE)
      KSTORE=LBYT(25,12,DORIN(2))
      CALL SBYT(25,12,DOROUT(2),KSTORE)
      KSTORE=LBYT(7,12,DORIN(2))
      CALL SBYT(13,12,DOROUT(2),KSTORE)
      KSTORE=LBYT(49,12,DORIN(3))
      CALL SBYT(1,12,DOROUT(2),KSTORE)
C     KEEP 1ST TIME OF FILE IN LIST
      IF(LIST(1,IFIL).EQ.1) LIST(2,IFIL)=DOROUT(2)
C
C     REMOVE 2ND CHAR. OF EACH 11 CHAR. WORD, STORE IN 10 CHAR WORDS
C     I=DORIN WORD, J=DORIN CHAR LOC, N=DOROUT WORD,KBIT=DOROUT CHAR LOC
      I=3
      J=43
      DO 144 N=3,NMAX
        JSKIP=12
        KBIT=55
        DO 140 K=1,10
          KSTORE=LBYT(J,6,DORIN(I))
          IF(KSTORE.EQ.SYMBOL(9)) GO TO 150
          CALL SBYT(KBIT,6,DOROUT(N),KSTORE)
          J=J-JSKIP
          JSKIP=6
          IF(J.GT.0) GO TO 135
            J=J+60
            I=I+1
  135     KBIT=KBIT-6
  140 CONTINUE
      IF(N.NE.4)GO TO 144
C     SKIP RECORD IF CONTINUOUS ALARM - TEST IF DATE OR CHANNEL
      ITEST=LBYT(55,6,DOROUT(N))
      DO 142 K=1,6
      IF(ITEST.EQ.SYMBOL(K)) GO TO 144
  142 CONTINUE
C     FOUND ANOTHER DATE - SKIP RECORD
  143 LIST(1,IFIL)=LIST(1,IFIL)-1
      GO TO 115
```

Appendix A-1. (Continued)

```
  144 CONTINUE
  145 CALL PRINT1(N)
      IF(N.LT.3) GO TO 115
      WRITE(4) N,(DOROUT(I),I=1,N)
      GO TO 115
  150 N=N-1
      IF(N.LT.3) GO TO 115
      GO TO 145
C
C     END OF FILE
  190 IF(EOI(3).NE.0) GO TO 195
      IF(LIST(1,IFIL).NE.0) LIST(3,IFIL)=DOROUT(2)
  192 IFIL=IFIL+1
      GO TO 110
C
C     END OF INFORMATION - PRINT LIST OF FILES
  195 CALL PRINT2
      STOP
      END
C
C
C
      SUBROUTINE PRINT1(N)
      COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
     1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
     2         IFIL,IMAX,NMAX,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
     3         PT172,PT150,TF173,TE148
      INTEGER ALARM,SIGN,POWERF,OK,SYMBOL,DORIN,DOROUT,BLANK
      DECODE(10,1020,DOROUT(2)) JDAY,POWERF,JHR,MIN1,MIN2,JSEC1,JSEC2
      IF(POWERF.EQ.OK) WRITE(5,1040) DOROUT(1),JDAY,JHR,MIN1,MIN2,JSEC1,
     1                 JSEC2
      IF(POWERF.NE.OK) WRITE(5,1050) DOROUT(1),JDAY,JHR,MIN1,MIN2,JSEC1,
     1                 JSEC2
      WRITE(5,1060)
      PT150=TE148=PT172=TF173=0.
      DO 220 I=3,N
        DECODE(10,1030,DOROUT(I)) ALARM,ICHAN,SIGN,DATA,IEXP
      IF(ICHAN.EQ.14.OR.ICHAN.EQ.19) IEXP=0
      IF(ICHAN.EQ.17.OR.ICHAN.EQ.18) IEXP=2
      IF(ICHAN.EQ.99) IEXP=3
C     CHANGE IEXP FOR TAPES 4 AND 5
      IF(IEXP.LE.0) IEXP=0
```

Appendix A-1. (Continued)

```
  230 ENCODE(10,1010,DOROUT(I)) DOROUT(I),IEXP
        IF(ICHAN.LE.IALCH.OR.ICHAN.EQ.90.OR.ICHAN.EQ.91.OR.ICHAN.EQ.99)
     1   GO TO 205
C      ALARM CHANNEL - NO DATA
  200 IF(ALARM.EQ.OK) GO TO 220
      DO 203 K=1,7
        IF(ALARM.EQ.SYMBOL(K)) AOUT=ALMPRT(K)
  203 CONTINUE
      WRITE(5,1080) ICHAN,PARAM(1,ICHAN+1),PARAM(2,ICHAN+1),TAG(ICHAN+1)
     1             ,AOUT
      GO TO 220
  205   DATA=DATA*10.**(-IEXP)
        IF(SIGN.EQ.SYMBOL(7)) DATA=-DATA
      IF(ICHAN.EQ.9) TE173=DATA
      IF(ICHAN.EQ.10) TE148=DATA
C     CONVERT MV TO SCFH
      IF(ICHAN.EQ.15.OR.ICHAN.EQ.16) CALL CALIBR(I)
C     CONVERT PSIG TO INCHES OF SLURRY
      IF(ICHAN.EQ.34.OR.ICHAN.EQ.35.OR.ICHAN.EQ.91) CALL DEPTH(I)
  208   DO 210 K=1,7
          IF(ALARM.EQ.SYMBOL(K)) AOUT=ALMPRT(K)
  210   CONTINUE
      IF(ICHAN.EQ.99) GO TO 212
      IF(ICHAN.EQ.17.OR.ICHAN.EQ.18.OR.ICHAN.EQ.21.
     1   OR.ICHAN.EQ.36.OR.ICHAN.EQ.37.OR.ICHAN.EQ.90) GO TO 214
      IF(ICHAN.EQ.0.OR.ICHAN.GE.24.AND.ICHAN.LE.33.
     1   OR.ICHAN.GE.38.AND.ICHAN.LE.40) GO TO 212
      IF(ICHAN.EQ.14.OR.ICHAN.EQ.19) GO TO 216
      WRITE(5,1072) ICHAN,PARAM(1,ICHAN+1),PARAM(2,ICHAN+1),TAG(ICHAN+1)
     1             ,DATA,UNITS(ICHAN+1),AOUT
      GO TO 220
  212 WRITE(5,1070) ICHAN,PARAM(1,ICHAN+1),PARAM(2,ICHAN+1),TAG(ICHAN+1)
     1             ,DATA,UNITS(ICHAN+1),AOUT
      GO TO 220
  214 WRITE(5,1071) ICHAN,PARAM(1,ICHAN+1),PARAM(2,ICHAN+1),TAG(ICHAN+1)
     1              ,DATA,UNITS(ICHAN+1),AOUT
      GO TO 220
  216 WRITE(5,1073) ICHAN,PARAM(1,ICHAN+1),PARAM(2,ICHAN+1),TAG(ICHAN+1)
     1             ,DATA,UNITS(ICHAN+1),AOUT
  220 CONTINUE
      RETURN
 1090 FORMAT(F3.0,1X,3F2.0)
```

Appendix A-1. (Continued)

```
 1091 FORMAT(A3,I6,I1)
C
C
 1010 FORMAT(A9,I1)
 1020 FORMAT(I3,R1,I2,4I1)
 1030 FORMAT(R1,I2,R1,F5.0,I1)
 1040 FORMAT(///2X,*RUN *,A10,3X,*DAY *,I3,3X,I2,2(*:*,2I1))
 1050 FORMAT(///2X,*RUN *,A10,3X,*DAY *,I3,3X,I2,2(*:*,2I1),4X,* POWER F
     1AILURE*)
 1060 FORMAT(*  CHANNEL  PARAMETER*,12X,*TAG*,12X,*DATA*,3X,*UNITS*,7X,
     1       *ALARM*)
 1070 FORMAT(  6X,I2,3X,2A10,1X,A9,2X,F10.3,2X,A10,2X,A10)
 1071 FORMAT(  6X,I2,3X,2A10,1X,A9,2X,F9.2,3X,A10,2X,A10)
 1072 FORMAT(  6X,I2,3X,2A10,1X,A9,2X,F8.1,4X,A10,2X,A10)
 1073 FORMAT(  6X,I2,3X,2A10,1X,A9,2X,F6.0,6X,A10,2X,A10)
 1080 FORMAT(  6X,I2,3X,2A10,1X,A9,26X,A10)
      END
C
C
C
      SUBROUTINE PRINT2
      COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
     1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
     2         IFIL,IMAX,NMAX,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
     3         PT172,PT150,TF173,TF148
      INTEGER ALARM,SIGN,POWERF,OK,SYMBOL,DORIN,DOROUT,BLANK
      WRITE(5,1110) DOROUT(1)
      WRITE(5,1120)
      DO 320 K=1,IFIL
      IF(LIST(1,K).GT.0) GO TO 310
      WRITE(5,1130) K,LIST(1,K)
      GO TO 320
  310 DECODE(10,1140,LIST(2,K)) JDAY,JHR,MIN1,MIN2,JSEC1,JSEC2
      DECODE(10,1140,LIST(3,K)) JDAYX,JHRX,MINX1,MINX2,JSECX1,JSECX2
      WRITE(5,1130) K,LIST(1,K),JDAY,JHR,MIN1,MIN2,JSEC1,JSEC2,JDAYX,
     1              JHRX,MINX1,MINX2,JSECX1,JSECX2
  320 CONTINUE
      RETURN
C
 1110 FORMAT(*1 RUN *,A10)
 1120 FORMAT(*  FILE  NO.RECORDS  1ST TIME       LAST TIME*)
 1130 FORMAT(3X,I3,8X,I3,3X,I3,1X,I2,2(*:*,2I1),3X,I3,1X,I2,2(*:*,2I1))
```

Appendix A-1. (Continued)

```
 1140 FORMAT(I3,1X,I2,4I1)
      END
C
C
C     USE CALIBRATION CURVES TO CONVERT MV TO SCFH
      SUBROUTINE CALIBR(I)
      COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
     1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
     2         IFIL,IMAX,NMAX,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
     3         PT172,PT150,TF173,TF148
      INTEGER DOROUT,SIGN,ALARM,SYMBOL
      DIMENSION XTABLE(15,18,2),YTABLE(15,18,2),ITARGL(6,2),LLMAX(18,2)
      DATA ITARGL/1,2,4*1,1,1,1,2,3,4/
      DATA LLMAX/13,15,15,13,14*15,13,13,12,12,12,12,14,13,13,14,13,13/
C     CH.15 HAS TARG1,2. CH.16 HAS TARG3,4,5,6(OTHERS WILL USE 1ST TARG)
C     CH.15 HAS 1 PRESSURE CURVE/TARGET(AVG OF INCR+DECR)
C     CH.16 HAS 3 PRESSURE CURVES/TARGET(AVG OF INCR+DECR)
      DATA XTABLE/
     1 0.,.11,.401,.908,1.22,1.412,1.814,2.345,2.827,3.213,3.75,4.103,
     2 3*4.623,30*0,
     3 0.,.042,.1035,.612,.811,1.211,2.460,3.05,3.544,4.33,4.8155,5.34,
     4 3*5.97,30*0,180*0,
     5 0.,.061,.214,.422,.937,1.413,1.831,2.318,2.813,3.221,3.724,4.102,
     6 3*4.607,0.,.0525,.223,.422,.924,1.417,1.8125,2.338,2.8175,3.212,
     7 3.728,4.129,3*4.609,0.,.105,.258,.638,1.167,1.627,2.073,2.569,
     8 3.040,3.725,4.150,4*4.618,
     90.,.057,.505,.722,1.523,2.324,3.005,3.825,4.106,4.95,5.423,4*5.836
     1,0.,.051,.51,.709,1.516,2.32,3.02,3.812,4.623,5.406,5.833,4*6.55,
     20.,.023,.056,.721,1.517,2.313,3.025,3.825,4.61,5.446,5.855,4*6.505
     3,0.,.012,.053,.1015,.452,.703,1.4065,2.1085,2.816,3.509,4.204,
     4 4.92,5.63,2*6.353,0.,.0525,.1085,.211,.312,.716,1.403,2.84,3.523,
     5 4.221,4.908,5.5265,3*6.348,0.,.115,.2065,.2995,.719,1.436,2.141,
     6 2.822,3.509,4.2545,4.950,5.604,3*6.327,
     7 0.,.1,.312,.511,.84,1.416,1.961,2.576,3.134,3.706,4.3,4.869,5.73,
     8 2*6.525,0.,.0395,.3105,.661,1.337,1.9375,2.637,3.221,3.934,4.583,
     9 5.237,5.842,3*6.54, 0.,.0225,.1005,.652,1.321,1.914,2.61,3.234,
     1 3.922,4.563,5.193,5.823,3*6.519/
      DATA (YTABLE(J),J=1,270)/
     1 0.,23.65,46.56,71.773,93.589,89.281,101.585,115.328,127.494,
     2 136.524,147.97,155.139,3*165.085,30*0,
     3 0.,28.413,45.245,107.401,123.544,150.242,213.059,237.149,255.298,
     4 274.785,296.289,312.058,3*329.827,30*0,180*0/
```

Appendix A-1. (Continued)

```
      DATA(YTABLE(J),J=271,405)/
     1 0.,10.879,21.792,30.691,46.432,57.387,65.328,73.503,80.978,
     2 86.593,92.916,97.418,3*102.888, 0.,16.354,35.505,49.073,72.3,
     3 89.117,100.455,113.945,125.142,133.815,144.281,152.107,3*161.074,
     4 0.,30.395,45.078,73.64,100.758,118.965,134.221,150.173,164.139,
     5 182.879,194.132,4*205.662,
     6 0.,21.182,64.047,76.639,111.503,138.342,157.696,178.259,195.172,
     7 203.696,213.32,4*221.837, 0.,31.464,100.427,118.49,173.038,
     8 214.605,245.159,276.795,303.677,327.779,341.041,4*360.298,
     9 0.,27.329,42.801,152.904,220.351,272.676,312.238,351.077,383.325,
     1 416.928,432.888,4*455.639,
     2 0.,19.711,42.397,59.284,120.966,150.031,211.05,258.093,298.586,
     3 332.462,365.372,396.649,425.859,2*454.309, 0.,65.696,92.971,
     4 126.282,156.011,234.738,327.158,463.894,517.441,567.935,613.166,
     5 651.575,3*698.598, 0.,120.309,163.457,194.598,297.155,419.336,
     6 509.282,585.901,657.025,724.186,780.749,829.497,3*883.389/
      DATA(YTABLE(J),J=406,450)/
     1 0.,120.481,208.139,265.533,336.302,438.45,517.216,588.373,650.159
     2 ,703.911,755.633,801.714,873.003,2*931.429,
     3 0.,118.193,320.715,472.663,661.965,810.4,954.051,1051.941,1157.01
     4 ,1252.652,1340.564,1408.89,3*1495.213,
     5 0.,114.487,234.513,394.343,849.128,1030.579,1199.833,1334.803,
     6 1475.078,1577.671,1697.56,1788.954,3*1897.803/
C
      IF(DATA.LT.0.) DATA=0.
      IF(DATA.EQ.0.) GO TO 370
      DATA=DATA*1E3
      LI=ICHAN-14
      J=ITARG(LI)
      J=ITARGL(J,LI)*3-2
C     FIND T,P FOR CORRECTIONS - IF NO T,P ON TAPE USE 0.
C     LOOK FOR CH.22 OR 23(P),  T ALREADY FOUND (CH.9 OR 10)
      DECODE(10,1220,DORNUT(LI+24)) ICH2,SN2,DAT2,IX2
      IF(ICH2.NE.(LI+21)) GO TO 330
  349 IF(IX2.LE.0) IX2=0
      DAT2=DAT2*10.**(-IX2)
      IF(SN2.EQ.SYMBOL(7)) DAT2=-DAT2
      GO TO 335
  330 KMAX=LI+23
      DO 332 K=3,KMAX
      DECODE(10,1220,DORNUT(K)) ICH2,SN2,DAT2,IX2
      IF(ICH2.EQ.(LI+21)) GO TO 349
```

Appendix A-1. (Continued)

```
  332 CONTINUE
      DAT2=0.
  335 IF(DAT2.LT.-10..OR.DAT2.GT.500.) GO TO 380
      IF(LI.GT.1) GO TO 337
      PT172=DAT2
      IF(TE173.LT.-10..OR.TE173.GT.500.) GO TO 380
      GO TO 341
  337 PT150=DAT2
      IF(TE148.LT.-10..OR.TE148.GT.500.) GO TO 380
C     GET CORRECT CURVE FOR PRESSURE - CH.16
      CORR=0.
      IF(PT150.LT.45.) GO TO 338
      IF(PT150.GT.95.) GO TO 339
      J=J+1
      GO TO 341
  338 CORR=-50.
      GO TO 341
  339 J=J+2
      CORR=50.
  341 LMAX=LLMAX(J,LI)
      DO 340 L=1,LMAX
      IF(DATA.LT.XTABLE(L,J,LI)) GO TO 345
  340 CONTINUE
      L=LMAX-2
      GO TO 348
  345 L=L-1
      IF(L.LT.1) L=1
      IF((L+2).GT.LMAX) L=L-1
  348 X0=XTABLE(L,J,LI)
      X1=XTABLE(L+1,J,LI)
      X2=XTABLE(L+2,J,LI)
      DATA=YTABLE(L,J,LI)*(DATA-X1)*(DATA-X2)/((X0-X1)*(X0-X2))
     1     +YTABLE(L+1,J,LI)*(DATA-X0)*(DATA-X2)/((X1-X0)*(X1-X2))
     2     +YTABLE(L+2,J,LI)*(DATA-X0)*(DATA-X1)/((X2-X0)*(X2-X1))
      IF(LI.GT.1) GO TO 350
C     CH.15  ADJUST SCFH FOR T,P (CURVE IS AT 200 PSIG, 70 F)
      DATA=DATA*.94*SQRT((PT172+14.7)*530./(214.7*(TE173+460.)))
      GO TO 370
C     CH.16  ADJUST SCFH FOR T,P (CURVE IS AT 20,70,120 PSIG AND 70 F)
  350 DATA=DATA*.94*SQRT((PT150+14.7)*530./((84.7+CORR)*(TE148+460.)))
C
C     CHANGE ALPHA INFO FOR TAPE4
```

Appendix A-1. (Continued)

```
  370 IEXP=1
      IDATA=DATA*10.+.5
      ENCODE(10,1210,DOROUT(I)) DOROUT(I),IDATA,IEXP
      RETURN
C     P OR T OVERRANGE - NO CALIBRATION POSSIBLE
  380 SIGN=SYMBOL(7)
      IDATA=99999
      IEXP=1
      ALARM=SYMBOL(5)
      ENCODE(10,1230,DOROUT(I)) ALARM,ICHAN,SIGN,IDATA,IEXP
      RETURN
 1210 FORMAT(A3,I6,I1)
 1220 FORMAT(1X,I2,R1,F5.0,I1)
 1230 FORMAT(R1,I2,R1,I5,I1)
      END
C
C
C
C     CONVERT PSIG TO DEPTH IN INCHES
      SUBROUTINE DEPTH(I)
      COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
     1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
     2         IFIL,IMAX,NWAY,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
     3         PT172,PT150,TF173,TF148
      INTEGER ALARM,SIGN,POWERF,OK,SYMBOL,DORIN,DOROUT,BLANK
C     CH.34(A1,B1 BY DENSITY), CH.35,91(A,B(2,3)), ALIM(4 ALARMS/CHAN)
      DIMENSION A1(4),B1(4),A(3),B(3),ALIM(4,3),DLIST(4)
      DATA A1/3.095,2.796,2.574,2.5/,B1/-7.4515,-7.46,-7.326,-7.5/,
     1     A/0.,1.167,4.416/,B/0.,11.,22.263/,
     2     ALIM/0.,4.,24.,27.5,13.2,15.5,27.5,28.5,35.5,40.5,83.5,88.5/,
     3     DLIST/1.0,1.1,1.2,1.24/
C
      IF(DATA.LT.0.) DATA=0.
      LI=ICHAN-33
      IF(LI.GT.1) GO TO 520
      DO 510 J=1,4
      IF(DENS.EQ.DLIST(J)) GO TO 515
  510 CONTINUE
  515 DATA=DATA*A1(J)+B1(J)
      GO TO 525
  520 IF(LI.GT.2) LI=3
      DATA=DATA*A(LI)+B(LI)
```

Appendix A-1. (Continued)

```
  525 IEXP=1
      IDATA=DATA*10.**IEXP+.5
C
C     CHECK FOR ALARMS
      IF(DATA.LE.ALIM(1,LI)) GO TO 530
      IF(DATA.LE.ALIM(2,LI)) GO TO 535
      IF(DATA.GE.ALIM(4,LI)) GO TO 540
      IF(DATA.GE.ALIM(3,LI)) GO TO 545
      K=6
      GO TO 550
  530 K=4
      GO TO 550
  535 K=2
      GO TO 550
  540 K=3
      GO TO 550
  545 K=1
  550 ALARM=SYMBOL(K)
      ENCODE(10,1510,DOROUT(I)) ALARM,ICHAN,IDATA,IEXP
      RETURN
 1510 FORMAT(R1,I2,I6,I1)
      END
C
C
      SUBROUTINE DIFF(I)
      COMMON/A/DORIN(113),DOROUT(113),LIST(3,100),PARAM(2,100),
     1         TAG(100),UNITS(100),SYMBOL(8),ALMPRT(7),ITARG(2),
     2         IFIL,IMAX,NMAX,BLANK,IALCH,OK,ICHAN,DATA,ALARM,DENS,
     3         PT172,PT150,TE173,TE148
      INTEGER DOROUT,SIGN,ALARM,SYMBOL
C     CONVERT MILLIVOLTS TO DEG F
C     USES THERMOCOUPLE CALIBR. FROM HANDBK CHEM/PHYS P. E-112
      DATA=DATA*1.8/.041
      IDATA=DATA*100.+.5
      IEXP=2
      ENCODE(10,1410,DOROUT(I)) DOROUT(I),IDATA,IEXP
      RETURN
 1410 FORMAT(A3,I6,I1)
      END
```

Appendix A-1. (Continued)

Sample Output

RUN 03-03-00 DAY 10 5:29:00

CHANNEL	PARAMETER	TAG	DATA	UNITS	ALARM
0	SELF CHECK	UJR-170	4.999	VOLTS	
1	T-2 CELL 1 TEMP	TE-19	137.0	DEG F	
2	T-2 CELL 2 TEMP	TE-20	135.1	DEG F	
3	T-2 CELL 3 TEMP	TE-21	129.2	DEG F	
4	R-1 CELL 1 TEMP	TE-52	211.8	DEG F	
5	R-1 CELL 2 TEMP	TE-53	203.7	DEG F	
6	R-1 CELL 3 TEMP	TE-54	206.1	DEG F	
7	R-1 CELL 4 TEMP	TE-55	207.1	DEG F	
8	R-1 CELL 5 TEMP	TE-56	206.9	DEG F	
9	OXYGEN TEMP TO R-1	TE-173	55.1	DEG F	
10	V-1 DISCH GAS TEMP	TE-148	55.1	DEG F	
11	LEACH TO V-1 TEMP	TE-199	50.5	DEG F	
12	LEACH FROM V-1 TEMP	TE-200	71.0	DEG F	
13	R-2 TEMP	TE-90	56.3	DEG F	
15	OXYGEN FLOW TO R-1	FE-41	6.6	SCFH	
16	V-1 DISCH GAS FLOW	FE-44	0.0	SCFH	
17	O2 ANAL REFERENCE	AE-171	98.59	PERCENT	
18	O2 ANAL SAMPLE	AE-171	20.07	PERCENT	
19	AUTOWEIGH TOTAL	WT-9	5661	POUNDS	
20	AUTOWEIGH RATE	WT-9A	-.3	POUNDS/HR	
21	R-1 PRESSURE	PT-173	-37.50	PSIG	
22	OXYGEN TO R-1	PT-172	.1	PSIG	
23	V-1 DISCH GAS PRESS	PT-150	23.3	PSIG	
24	P-1 DISCHARGE FLOW	FE-29	.974	GPM	
25	P-2 DISCHARGE FLOW	FE-83	.872	GPM	
26	P-3 DISCHARGE FLOW	FE-84	.659	GPM	
27	P-4 DISCHARGE FLOW	FE-85	1.797	GPM	
28	P-5 DISCHARGE FLOW	FE-86	.454	GPM	
29	P-6 DISCHARGE FLOW	FE-87	-.077	GPM	
30	T-3 LEACH FLOW	FE-31	-.014	GPM	
31	P-9 DISCHARGE FLOW	FE-157	.006	GPM	
32	P-10 DISCHARGE FLOW	FE-158	.005	GPM	
33	P-7 DISCHARGE FLOW	FE-101	-1.250	GPM	
34	T-2 SLURRY LEVEL	PT-26	12.9	INCHES	
35	R-1 SLURRY LEVEL	PT-58	11.0	INCHES	LOWER
36	PUMP P-1 DISCH PRESS	PT-28	-50.19	PSIG	
37	N2 SUPPLY TO R-1	PT-307	43.10	PSIG	
38	S-1 VACUUM PAN A	PT-249	14.550	PSIA	
39	S-1 VACUUM PAN B	PT-250	-3.760	PSIA	
40	RAMAPO Ex. MONITOR		-0.000	VOLTS	
41	LEACH SL TEMP TO T-3	TE-32	56.0	DEG F	
42	T-4 TANK TEMP	TE-201	64.2	DEG F	
43	V-1 TANK TEMP	TE-202	58.9	DEG F	
44	T-4 H2O IN TEMP	TE-203	68.5	DEG F	
45	T-10 FLUSH H2O TEMP	TE-195	69.4	DEG F	
46	P-1 DISCH TEMP	TE-28	91.2	DEG F	
47	S1 INLET TEMP SLURRY	TE-	58.9	DEG F	
48	T-4 H2O OUT TEMP	TE-204	68.0	DEG F	
90	PUMP P-7 DISCH PRESS	PT-100	-8.26	PSIG	
91	R-2 LIQUID LEVEL	PT-95	22.3	INCHES	LOWER
99	XDUCER P.S. MONITOR		14.568	MV	

Appendix A-1. (Continued)

```
      PROGRAM DORTIN(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE4,
     1               TAPE5,TAPE6)
C
C     WRITTEN 8/16/77  DEBBIE HOPP  247360
C     PRINTS CHANNELS IN GROUPS OF 12 BY TIME PERIODS
C     T(1)=MIN,T(2)=MAX,T(3)=MIN TIME INTERVAL  (TAPE6)
C     TAPE4 IS OUTPUT FROM DORIC PROGRAM (CONVERTED DATALOGGER TAPE)
C
      COMMON/A/DORIN(113),PDATA(12,800),TIME(800),NOCHAN,
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,IP,ICH(100),
     2         NAMCH(100),NOWCH(32),NCHAN,NPG,LASTCH,IALCH,SKIP,IAVG,
     3  TIMN,DATN(12),PARAM(2,100),TAG(100),UNITS(100),HEAD1(7),HEAD2(7)
     4  ,ALARM,SYMBOL(6),ALMPRT(6),IACH(32),IEND,NALCH,HEAD3
      DIMENSION P(9600),IPD(9600)
      INTEGER SIGN,RUN,DORIN,SKIP,ALARM,SYMBOL,ALMPRT,ADUT,HEAD3
      REAL M
C     IALCH IS LAST DATA CHANNEL IN 1ST BLOCK
C     NOCHAN IS NO. OF DATA CHANNELS
C     NALCH IS NO. OF ALARM CHANNELS
      DATA MINUS/1H-/,MAXP/9600/,IALCH/48/,NOCHAN/52/,NALCH/25/
      DATA SYMBOL/1R>,1R<,1R),1R(,1R*,1R /,
     1     ALMPRT/3H  H,3H  L,3H HH,3H LL,3H OR,3H   /
      DATA UNITS/10HVOLTS      ,10HDEG F      ,10HDEG F      ,10HDEG F
     1,     10HDEG F      ,10HDEG F      ,10HDEG F      ,10HDEG F      ,
     2      10HDEG F      ,10HDEG F      ,10HDEG F      ,10HDEG F      ,
     3      10HDEG F      ,10HDEG F      ,10HGALLONS    ,10HSCFH       ,
     4      10HSCFH       ,10HPERCENT    ,10HPERCENT    ,10HPOUNDS     ,
     5      10HPOUNDS/HR ,10HPSIG       ,10HPSIG       ,10HPSIG       ,
     6      10*10HGPM         ,10HINCHES     ,10HINCHES     ,10HPSIG       ,
     7      10HPSIG       ,10HPSIA       ,10HPSIA       ,10HVOLTS      ,
     8      8*10HDEG F      ,41*1H ,10HPSIG       ,10HINCHES     ,7*1H ,
     9      10HMV         /
      DATA (PARAM(I),I=1,65)
     1/11HSELF CHECK ,15HT-2 CELL 1 TEMP,15HT-2 CELL 2 TEMP,
     1      15HT-2 CELL 3 TEMP,15HR-1 CELL 1 TEMP,15HR-1 CELL 2 TEMP,
     2      15HR-1 CELL 3 TEMP,15HR-1 CELL 4 TEMP,15HR-1 CELL 5 TEMP,
     318HOXYGEN TEMP TO R-1,18HV-1 DISCH GAS TEMP,18HLEACH TO V-1 TEMP ,
     419HLEACH FROM V-1 TEMP,11HP-2 TEMP   ,19HR-1 DISCHARGE TOTAL,
     518HOXYGEN FLOW TO R-1,18HV-1 DISCH GAS FLOW,18HO2 ANAL REFERENCE ,
     615HO2 ANAL SAMPLE ,15HAUTOWEIGH TOTAL,15HAUTOWEIGH RATE ,
     715HR-1 PRESSURE   ,15HOXYGEN TO R-1  ,19HV-1 DISCH GAS PRESS,
     818HP-1 DISCHARGE FLOW,18HP-2 DISCHARGE FLOW,18HP-3 DISCHARGE FLOW,
```

Appendix A-2. Computer Program for Tabulating Doric Data in the Abbreviated Format.

```
918HP-4 DISCHARGE FLOW,18HP-5 DISCHARGE FLOW,18HP-6 DISCHARGE FLOW,
114HT-3 LEACH FLOW,18HP-9 DISCHARGE FLOW,19HP-10 DISCHARGE FLOW/
 DATA (PARAM(I),I=67,200)/
118HP-7 DISCHARGE FLOW,16HT-2 SLURRY LEVEL,16HR-1 SLURRY LEVEL,
220HPUMP P-1 DISCH PRESS,16HN2 SUPPLY TO R-1,16HS-1 VACUUM PAN A,
316HS-1 VACUUM PAN B,18HRAMAPO EX. MONITOR,20HLEACH SL TEMP TO T-3,
413HT-4 TANK TEMP,13HV-1 TANK TEMP,15HT-4 H2O IN TEMP,
519HT-10 FLUSH H2O TEMP,14HP-1 DISCH TEMP,20HS1 INLET TEMP SLURRY,
6 16HT-4 H2O OUT TEMP,12*1H ,
315HP-16 FLOW ALARM,15HN2 TO T-1       ,15HFEED TANK T-1  ,
416HA.W. DELIVERY HI,16HA.W. DELIVERY LO,12HT-2 HIGH LVL,
511HT-2 LO LVL ,13HR-1 HI HI LVL,11HR-1 HI LVL ,11HR-1 LO LVL ,
613HR-1 LO LO LVL,15HR-1 HI PRESSURE,18HR-1 MIX MOTORS OFF,
718HV-1 TANK LO LVL    ,18HT-5 HI LVL         ,18HT-4 HI LVL         ,
818HK-1 VACUUM OFF     ,18HOXY SUPPLY LO LVL ,18HINST. AIR LO LVL  ,
919HSTEAM SUPPLY LO LVL,15HN2 PURGE LO LVL,18HN2 MANIFOLD LO LVL,
118HT-10 WATER LO LVL ,18HT-6 HI LVL         ,18HR-2 HI LO LVL      ,
220*1H ,20HPUMP P-7 DISCH PRESS,16HR-2 LIQUID LEVEL,14*1H ,
319HXDUCER P.S. MONITOR/
 DATA TAG/8HUJR-170 ,8HTE-19    ,8HTE-20    ,8HTE-21    ,8HTE-52    ,
16HTE-53    ,8HTE-54    ,8HTE-55    ,8HTE-56    ,8HTE-173   ,8HTE-148   ,
26HTE-199   ,8HTE-200   ,8HTE-99    ,8HFE-60    ,8HFE-61    ,8HFE-44    ,
38HAE-171   ,8HAE-171   ,8HWT-9     ,8HWT-9A    ,8HPT-173   ,8HPT-172   ,
48HPT-150   ,8HFE-29    ,8HFE-83    ,8HFE-84    ,8HFE-85    ,8HFE-86    ,
58HFE-87    ,8HFE-31    ,8HFE-157   ,8HFE-158   ,8HFE-101   ,8HPT-26    ,
68HPT-58    ,8HPT-28    ,8HPT-307   ,8HPT-249   ,8HPT-250   ,8H          ,
78HTE-32    ,8HTE-201   ,8HTE-202   ,8HTE-203   ,8HTE-195   ,8HTE-28    ,
88HTE-      ,8HTE-204   ,6*1H ,
88HFSL-237 ,8HPSL-191 ,8HLSL-8    ,8HWSH-9    ,8HWSL-9    ,8HLSH-26   ,
98HLSL-26   ,8HLSH4-58 ,8HLSHL-58A,8HLSHL-588,8HLSL-59   ,8HPSH-151 ,
18HM4 TO M8,8HLSL-37  ,8HLSH-88   ,8HLSH-91   ,8H          ,8HPSL-163 ,
28HPSL-164 ,8HPSL-165 ,8HPSL-168 ,8HPSL-169 ,8HLSL-175 ,8HLSH-120 ,
36HLSHL-95 ,10*1H ,8HPT-100   ,8HPT-95    ,6*1H /
 DATA ICH/0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,
1          22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,
2          41,42,43,44,45,46,47,48,90,91,99/
 DATA IACH/55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,
Z          73,74,75,76,77,78,79/
 EQUIVALENCE (PDATA,P),(PDATA,IPD)
C
 REWIND 5
 REWIND 6
```

Appendix A-2. (Continued)

```
      L=0
      DO 59 I=1,MAXP
   59 P(I)=-0.0
C     READ HEADING
      READ(6,1000) HEAD1,HEAD2
 1000 FORMAT (7A10)
      IP=0
      CALL RDTIME
C     READ MIN,MAX TIMES, MIN TIME INTERVAL, CHANNELS
C
   62 IF(IAVG.NE.0) GO TO 205
   60 READ(4) N,(DORIN(I),I=1,N)
      IF(EOF,4) 180,80
   80 DECODE(10,1080,DORIN(2)) D(4),H(4),M(4),S(4)
 1080 FORMAT(F3.0,1X,3F2.0)
      T(4)=24.*D(4)+H(4)+M(4)/60.+S(4)/3600.
   85 IF(T(4).LT.T(1))GO TO 60
      IF(T(4).GT.T(2)) GO TO 180
      IF(L.EQ.0) GO TO 90
      IF((T(4)-TIME(L)).LT.T(3)) GO TO 60
   90 L=L+1
      HEAD3=DORIN(1)
      TIME(L)=T(4)
      ISIG=0
      DO 100 I=3,N
      DECODE(10,1100,DORIN(I)) ALARM,ICHAN,SIGN,DATA,IEXP
 1100 FORMAT(R1,I2,R1,F5.0,I1)
   91 DO 92 J=1,NPG
      IF(ICHAN.EQ.NOWCH(J)) GO TO 93
   92 CONTINUE
      GO TO 100
   93 IF(ICHAN.LE.IALCH.OR.ICHAN.EQ.90.OR.ICHAN.EQ.91.OR.ICHAN.EQ.99)
     1   GO TO 94
C     ALARM CHANNEL - IGNORE IF BLANK
      IF(ALARM.EQ.SYMBOL(6)) GO TO 100
      DO 110 K=1,5
      IF(ALARM.EQ.SYMBOL(K)) AOUT=ALMPRT(K)
  110 CONTINUE
C     STORE SYMBOL IN 3 CHARACTERS OF WORD
      JWORD=(J-1)/3+1
      JCHAR=MOD((J-1),3)+1
      GO TO (120,125,130),JCHAR
```

Appendix A-2. (Continued)

```
  120 ENCODE(10,1200,PDATA(JWORD,L)) ADUT,PDATA(JWORD,L)
      GO TO 96
  125 ENCODE(10,1250,PDATA(JWORD,L)) PDATA(JWORD,L),ADUT,PDATA(JWORD,L)
      GO TO 96
  130 ENCODE(10,1300,PDATA(JWORD,L)) PDATA(JWORD,L),ADUT
      GO TO 96
 1200 FORMAT(A3,R7)
 1250 FORMAT(A3,A3,R4)
 1300 FORMAT(A6,A4)
   94 DATA=DATA*10.**(-IEXP)
      IF(SIGN.EQ.MINUS) DATA=-DATA
      PDATA(J,L)=DATA
   96 ISIG=ISIG+1
  100 CONTINUE
      IF(ISIG.EQ.0) L=L-1
      GO TO 60
  180 IF(IEND.EQ.1) GO TO 190
      IF(L.GT.0) CALL OUT
      IF(LASTCH.GE.NCHAN) GO TO 185
C     NEXT SET OF 12
  183 ITEMP=LASTCH+12
      ITEMP=MIN0(ITEMP,NCHAN)
      NPG=ITEMP-LASTCH
      LASTCH=ITEMP
      DO 184 I=1,NPG
  184 NOWCH(I)=NAMCH(LASTCH-NPG+I)
  181 REWIND 4
      IF(SKIP.LE.0) GO TO 62
      DO 182 I=1,SKIP
  182 READ(4)
      GO TO 62
C     SET UP FOR ALARM CHANNELS - 3 GROUPS OF 3 CHAR/WORD
  185 IEND=1
      NPG=NALCH
      DO 187 I=1,NPG
  187 NOWCH(I)=IACH(I)
      DO 188 I=1,MAXP
  188 IPD(I)=ALMPRT(6)
      GO TO 181
  190 CALL OUT2
      CALL RDTIME
      GO TO 62
```

Appendix A-2. (Continued)

```
C
C     AVERAGED DATA
  205 TIMN=0.
      DO 206 I=1,12
  206 DATN(I)=0.
  210 READ(4) N,(DORIN(I),I=1,N)
      IF(EOF,4) 180,220
  220 DECODE(10,1080,DORIN(2)) D(4),H(4),M(4),S(4)
      T(4)=24.*D(4)+H(4)+M(4)/60.+S(4)/3600.
      IF(T(4).LT.T(1)) GO TO 210
      IF(T(4).GT.T(2)) GO TO 250
      IF(L.EQ.0) GO TO 245
  225 IF((T(4)-TIME(L).GT.T(3)) GO TO 240
  228 ISIG=0
      IMAX=MIN0(N,NMAX)
      DO 235 I=3,IMAX
      DECODE(10,1100,DORIN(I)) ICHAN,SIGN,DATA,IEXP
      IF(ICHAN.EQ.90.OR.ICHAN.EQ.91) GO TO 229
      IF(ICHAN.EQ.0.OR.ICHAN.GT.IALCH) GO TO 235
  229 DO 230 J=1,NPG
      IF(ICHAN.EQ.NOWCH(J)) GO TO 232
  230 CONTINUE
      GO TO 235
  232 DATA=DATA*10.**(-IEXP)
      IF(SIGN.EQ.MINUS) DATA=-DATA
      PDATA(J,L)=PDATA(J,L)+DATA
      DATN(J)=DATN(J)+1.
      ISIG=ISIG+1
  235 CONTINUE
      IF(ISIG.EQ.0) GO TO 210
      TIME(L)=TIME(L)+T(4)
      TIMN=TIMN+1.
      GO TO 210
C     END OF INTERVAL - AVERAGE DATA
  240 IF(TIMN.EQ.0.) GO TO 228
      TIME(L)=TIME(L)/TIMN
      DO 242 I=1,NPG
      IF(DATN(I).EQ.0.) GO TO 242
      PDATA(I,L)=PDATA(I,L)/DATN(I)
      DATN(I)=0.
  242 CONTINUE
      TIMN=0.
```

Appendix A-2. (Continued)

```
  245 L=L+1
      TIMLL=T(4)
      HEAD3=DDRIN(1)
      GO TO 228
  250 IF(TIMN.EQ.0.) GO TO 255
      TIME(L)=TIME(L)/TIMN
      DO 252 I=1,NPG
      IF(DATN(I).EQ.0.) GO TO 252
      PDATA(I,L)=PDATA(I,L)/DATN(I)
  252 CONTINUE
      GO TO 180
  255 L=L-1
      GO TO 180
      END
C
C
      SUBROUTINE RDTIME
      COMMON/A/DDRIN(113),PDATA(12,800),TIME(800),NOCHAN,
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,IP,ICH(100),
     2         NAMCH(100),NOWCH(32),NCHAN,NPG,LASTCH,IALCH,SKIP,IAVG,
     3  TIMN,DATN(12),PARAM(2,100),TAG(100),UNITS(100),HEAD1(7),HEAD2(7)
     4  ,ALARM,SYMBOL(6),ALMPRT(6),IACH(32),IEND,NALCH,HEAD3
      INTEGER SIGN,RUN,DDRIN,SKIP
      REAL M
C
      IEND=0
      ACCEPT(6) ((D(I),H(I),M(I),S(I)),I=1,3),IAVG
      IF(EOF,6) 58,45
   45 DO 50 I=1,3
   50 T(I)=24.*D(I)+H(I)+M(I)/60.+S(I)/3600.
C     READ CHANNELS WANTED
      ACCEPT(6) SKIP,NCHAN
      IF(NCHAN.EQ.0) GO TO 57
      ACCEPT(6) (NAMCH(I),I=1,NCHAN)
      LASTCH=MINO(12,NCHAN)
      DO 52 J=1,LASTCH
   52 NOWCH(J)=NAMCH(J)
      NPG=LASTCH
      REWIND 4
      IF(SKIP.LE.0) RETURN
      DO 55 I=1,SKIP
   55 READ(4)
```

Appendix A-2. (Continued)

```
      RETURN
   57 DISPLAY *NO. OF CHANNELS REQUESTED=0; ERROR*
   58 STOP
      END
C
C
      SUBROUTINE OUT
      COMMON/A/DORIN(113),PDATA(12,900),TIME(800),NOCHAN,
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,IP,ICH(100),
     2         NAMCH(100),NOWCH(32),NCHAN,NPG,LASTCH,IALCH,SKIP,IAVG,
     3  TIMN,DATN(12),PARAM(2,100),TAG(100),UNITS(100),HEAD1(7),HEAD2(7)
     4  ,ALARM,SYMBOL(6),ALMPRT(6),IACH(32),IEND,NALCH,HEAD3
      DIMENSION FORMOUT(16),FORM(4),FTAG(12),IT(6),P(9600)
      DATA FORMOUT/22H(I4,I3,1H:,2I1,1H:,2I1/,FORMOUT(16)/1H)/,
     1     BLANK/10H          /,FORM/10H,F7.0,1X  ,10H,F8.1     ,
     2     10H,F8.2     ,10H,F8.3     /
      EQUIVALENCE (PDATA,P)
C
      IF(.?.NE.0) GO TO 405
C     WRITE HEADER PAGES
      P=1
      WRITE(5,1010) HEAD3,D(1)
      DO 70 I=1,30
      J=ICH(I)
      IF((I+30).GT.NOCHAN) GO TO 68
      K=ICH(I+30)
      WRITE(5,1020) J,PARAM(1,J+1),PARAM(2,J+1),TAG(J+1),UNITS(J+1),
     1              K,PARAM(1,K+1),PARAM(2,K+1),TAG(K+1),UNITS(K+1)
      GO TO 70
   68 WRITE(5,1025) J,PARAM(1,J+1),PARAM(2,J+1),TAG(J+1),UNITS(J+1)
   70 CONTINUE
      WRITE(5,1030) HEAD1,HEAD2
      WRITE(5,1040) HEAD3,D(1)
      DO 480 I=1,NALCH
      J=IACH(I)
      WRITE(5,1020) J,PARAM(1,J+1),PARAM(2,J+1),TAG(J+1)
  480 CONTINUE
 1010 FORMAT(1H1,40X,*RUN *,A10,5X,*DAY *,F3.0//2X,*CHANNEL PARAMETER*,
     1   12X,*TAG*,7X,*UNITS*,14X,*CHANNEL PARAMETER*,12X,*TAG*,7X,
     2       *UNITS*)
 1020 FORMAT(6X,I2,2X,2A10,1X,A8,2X,A10,7X,6X,I2,2X,2A10,1X,A8,2X,A10)
 1025 FORMAT(6X,I2,2X,2A10,1X,A8,2X,A10)
```

Appendix A-2. (Continued)

```
1030 FORMAT(//5X,7A10/5X,7A10)
1040 FORMAT(1H1,40X,*RUN *,A10,5X,*DAY *,F3.0/2X,*ALARM*/2X,*CHANNEL PA
    1RAMETER*,12X,*TAG*)
 405 DO 410 J=1,NPG
     I=NOWCH(J)
 410 FTAG(J)=TAG(I+1)
     DO 420 J=4,15
 420 FORMOUT(J)=BLANK
     DO 450 J=1,NPG
     I=NOWCH(J)+1
     IF(I.EQ.91) GO TO 435
     IF(I.EQ.92) GO TO 430
     IF(I.EQ.100) GO TO 440
     GO TO (440,430,430,430,430,430,430,430,430,430,430,430,430,430,
    1        425,430,430,435,435,425,430,435,430,430,440,440,440,440,
    2        440,440,440,440,440,440,430,430,435,435,440,440,440,430,
    3       430,430,430,430,430,430,430),I
 425 FORMOUT(J+3)=FORM(1)
     GO TO 450
 430 FORMOUT(J+3)=FORM(2)
     GO TO 450
 435 FORMOUT(J+3)=FORM(3)
     GO TO 450
 440 FORMOUT(J+3)=FORM(4)
 450 CONTINUE
     LCOUNT=38
     DO 460 I=1,L
     IF(LCOUNT.LT.38) GO TO 452
C    PRINT 3 LINE HEADING - NEW PAGE
     LCOUNT=0
     IF(IAVG.NE.0) WRITE(5,2000) DURIN(1),(NOWCH(J),J=1,NPG)
     IF(IAVG.EQ.0) WRITE(5,2010) DURIN(1),(NOWCH(J),J=1,NPG)
     WRITE(5,2020) (FTAG(J),J=1,NPG)
 452 X=TIME(I)
     IY=INT(X)
     IT(1)=X/24.
     IT(2)=IY-IT(1)*24
     Y=IY
     IT(3)=(X-Y)*60.
     IT(5)=(X-Y)*3600.-IT(3)*60+.5
     IF(IT(5).NE.60) GO TO 455
     IT(3)=IT(3)+1
```

Appendix A-2. (Continued)

```
      IT(5)=0
  455 ITEMP=IT(3)/10
      IT(4)=MOD(IT(3),10)
      IT(3)=ITEMP
      ITEMP=IT(5)/10
      IT(6)=MOD(IT(5),10)
      IT(5)=ITEMP
      WRITE(5,FORMOUT) (IT(K),K=1,6),(PDATA(J,I),J=1,NPG)
      LCOUNT=LCOUNT+1
  460 CONTINUE
      L=0
      DO 470 I=1,MAXP
  470 P(I)=-0.0
      RETURN
 2000 FORMAT(1H1,12X,13HAVERAGED DATA/13X,12(8H CHANNEL)/
     1        5H RUN ,A10,12(3X,I2,3X))
 2010 FORMAT(1H1,12X,12(8H CHANNEL)/5H RUN ,A10,12(3X,I2,3X))
 2020 FORMAT(14H DAY  TIME    ,12A8)
      END
C
C
C
      SUBROUTINE OUT2
      COMMON/A/DORIN(113),PDATA(12,800),TIME(800),NOCHAN,
     1          D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,IP,ICH(100),
     2          NARCH(100),NOWCH(32),NCHAN,NPG,LASTCH,IALCH,SKIP,IAVG,
     3  TIMN,DATN(12),PARAM(2,100),TAG(100),UNITS(100),HEAD1(7),HEAD2(7)
     4  ,ALARM,SYMBOL(6),ALMPRT(6),IACH(32),IEND,NALCH,HEAD3
      DIMENSION IT(6),P(9600)
      EQUIVALENCE (PDATA,P)
      LCOUNT=38
      NP=(NPG+2)/3
      DO 560 I=1,L
      IF(LCOUNT.LT.38) GO TO 552
C     PRINT HEADING - NEW PAGE
      LCOUNT=0
      WRITE(5,3010) HEAD3,(NOWCH(J),J=1,NPG)
      WRITE(5,3020)
  552 X=TIME(I)
      IY=INT(X)
      IT(1)=X/24.
      IT(2)=IY-IT(1)*24
```

Appendix A-2. (Continued)

```
      Y=IY
      IT(3)=(X-Y)*60.
      IT(5)=(X-Y)*3600.-IT(3)*60+.5
      IF(IT(5).NE.60) GO TO 555
      IT(3)=IT(3)+1
      IT(5)=0
  555 ITEMP=IT(3)/10
      IT(4)=MOD(IT(3),10)
      IT(3)=ITEMP
      ITEMP=IT(5)/10
      IT(6)=MOD(IT(5),10)
      IT(5)=ITEMP
      WRITE(5,3030) (IT(K),K=1,6),(PDATA(J,I),J=1,NP)
      LCOUNT=LCOUNT+1
  560 CONTINUE
      L=0
      DO 570 I=1,MAXP
  570 P(I)=-0.0
      RETURN
 3010 FORMAT(1H1,15X,14HALARM CHANNELS/5H RUN ,A10,3213)
 3020 FORMAT(10H DAY  TIME)
 3030 FORMAT(I4,I3,1H:,2I1,1H:,2I1,2X,11A4)
      END
```

Appendix A-2. (Continued)

Sample Output

RUN DAY	83-03-30 TIME	CHANNEL 0 UJP-170	CHANNEL 1 TE-19	CHANNEL 2 TE-20	CHANNEL 3 TE-21	CHANNEL 4 TE-52	CHANNEL 5 TE-53	CHANNEL 6 TE-54	CHANNEL 7 TE-55	CHANNEL 8 TE-56	CHANNEL 9 TE-173	CHANNEL 10 TE-148	CHANNEL 11 TE-149
10	5:11:00	4.999	140.2	139.4	133.3	209.3	204.6	207.6	209.4	207.5	55.3	54.7	57.1
10	5:14:00	4.999	139.9	138.8	132.7	209.8	204.0	207.3	209.2	207.8	55.2	55.6	56.7
10	5:17:00	4.999	139.3	137.3	132.0	211.9	203.8	207.1	208.7	207.8	55.3	54.8	59.0
10	5:20:00	4.999	138.4	136.9	131.3	210.3	203.6	206.8	208.1	206.9	55.2	55.1	57.4
10	5:23:00	4.999	138.3	136.3	130.7	212.2	203.4	206.1	207.8	207.3	55.2	55.1	56.6
10	5:26:00	4.999	137.4	135.7	130.0	212.3	203.3	205.8	207.5	206.5	55.1	55.1	59.4
10	5:29:00	4.999	137.0	135.1	129.2	211.8	203.7	206.1	207.1	206.9	55.1	55.1	59.5
10	5:32:00	4.999	136.7	135.4	128.3	211.6	203.4	205.3	207.0	206.5	55.0	54.5	58.0
10	5:35:00	4.999	135.7	134.6	127.4	211.4	203.3	205.0	206.5	206.2	55.0	55.6	56.9
10	5:38:00	4.999	135.7	134.3	127.0	212.3	202.5	205.4	206.2	205.7	55.0	55.6	59.5
10	5:41:00	4.999	134.5	133.7	126.3	209.5	202.3	204.6	206.6	205.4	55.0	54.4	57.9
10	5:44:00	4.999	134.0	133.1	126.1	211.1	202.6	204.8	206.2	205.2	55.2	54.5	58.6
10	5:47:00	4.999	133.4	131.4	125.6	211.5	202.6	204.0	205.5	205.3	55.2	55.6	57.4
10	5:50:00	4.999	132.0	131.0	125.1	212.7	204.6	203.8	205.3	204.7	55.2	54.4	58.0
10	5:53:00	4.999	132.5	130.5	124.6	212.0	202.2	203.5	205.5	205.0	55.3	54.4	58.2
10	5:56:00	4.999	132.4	130.0	124.3	213.7	202.1	203.3	204.9	204.7	55.4	54.5	59.8
10	5:59:00	4.999	131.8	130.2	123.8	213.2	202.4	203.1	204.4	204.4	55.6	55.1	58.6
10	6:02:00	4.999	131.1	128.8	123.5	211.2	201.4	202.6	204.2	203.9	55.7	54.9	58.3
10	6:05:00	4.999	130.0	129.3	123.0	211.9	200.9	202.7	204.0	204.0	55.5	54.9	58.4
10	6:08:00	4.999	130.4	129.1	122.7	212.0	201.4	202.9	203.8	203.4	55.6	54.9	57.8
10	6:11:00	4.999	129.7	127.6	122.3	207.8	201.6	202.2	204.0	203.0	55.6	54.9	55.7
10	6:14:00	4.999	129.0	127.2	121.9	209.7	201.0	202.3	203.1	203.4	55.7	55.0	56.3
10	6:19:00	4.999	128.1	127.3	121.4	210.6	200.7	202.0	202.7	202.6	55.4	54.6	56.9
10	6:24:00	4.999	127.5	125.9	120.9	209.5	200.4	201.7	202.9	202.2	56.0	55.1	56.5
10	6:29:00	4.999	127.1	125.1	120.3	210.4	199.5	200.9	202.5	202.2	56.1	55.2	56.2
10	6:34:00	4.999	126.4	125.3	119.8	210.7	199.6	201.0	201.4	201.4	56.1	55.3	56.7
10	6:39:00	4.999	125.8	124.5	119.1	209.5	199.5	200.1	201.0	201.5	56.2	55.3	55.7
10	6:44:00	4.999	124.8	123.0	118.5	209.4	199.2	199.8	200.7	201.2	56.2	55.3	55.8
10	6:49:00	4.999	124.5	123.4	118.0	207.6	198.9	199.4	200.2	200.4	56.2	55.3	55.6
10	6:54:00	4.999	123.9	122.8	117.4	208.2	198.7	199.2	199.9	200.5	56.4	55.5	55.7
10	6:59:00	4.999	123.1	122.1	117.0	209.8	198.4	199.3	199.5	200.2	56.5	55.5	55.9
10	7:04:00	4.999	122.4	121.7	116.5	210.0	198.1	199.0	199.3	199.4	56.7	55.1	56.4
10	7:09:00	4.999	121.7	121.0	116.0	208.9	197.4	198.7	199.4	199.1	56.8	55.7	55.8
10	7:14:00	4.999	121.6	120.3	115.5	208.6	197.7	197.9	199.0	199.2	56.9	55.3	55.9
10	7:19:00	4.999	121.1	119.7	115.0	208.8	196.8	197.6	198.6	198.8	57.0	55.6	55.8
10	7:24:00	4.999	120.5	119.0	114.4	207.3	197.0	197.7	198.1	198.0	56.9	55.8	55.8
10	7:29:00	4.999	119.8	118.9	113.8	208.9	196.8	197.5	198.1	197.8	56.9	55.9	56.2
10	7:34:00	4.999	119.8	118.3	113.4	207.1	196.6	196.6	197.6	197.8	56.8	55.7	55.7

Appendix A-2. (Continued)

```
      PROGRAM DORPLOT(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE4,
     1                TAPE6,TAPE50)
C
C     WRITTEN 8/19/77  DEBBIE HOPP  247360
C     PLOTS UP TO 8 CHANNELS PER PAGE VS. TIME
C     T(1)=MIN,T(2)=MAX,T(3)=MIN TIME INTERVAL  (TAPE6)
C     T(1) IS 0 TIME, PLOT TIMES ARE IN HRS+FRAC OF HRS
C     TAPE4 IS OUTPUT FROM DORIC PROGRAM (CONVERTED DATALOGGER TAPE)
C
      COMMON/A/DORIN(113),PDATA(800,8),TIME(800),
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2         NAMCH(8),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3         TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
      DATA NMAX/102/,MINUS/1R-/,MAXP/6400/,IALCH/48/
      DATA TITLE/5H  DAY,9H      RUN/
C
      REWIND 4
      REWIND 6
      REWIND 50
      ACCEPT(6) XLNGTH
      XMOVE=XLNGTH+1.25
      CALL LOOK(50)
      CALL RDTIME
C     READ MIN,MAX TIMES, MIN TIME INTERVAL
C
   60 READ(4) N,(DORIN(I),I=1,N)
      IF(EOF,4) 180,80
   80 DECODE(10,1080,DORIN(2)) D(4),H(4),M(4),S(4)
 1080 FORMAT(F3.0,1X,3F2.0)
      T(4)=24.*D(4)+H(4)+M(4)/60.+S(4)/3600.
   85 IF(T(4).LT.T(1))GO TO 60
      IF(T(4).GT.T(2)) GO TO 180
      IF(L.EQ.0) GO TO 90
      IF((T(4)-DAY-TIME(L)).LT.T(3)) GO TO 60
   90 L=L+1
      TITLE(3)=DORIN(1)
      TIME(L)=T(4)-DAY
      ISIG=0
      IMAX=MIN0(N,NMAX)
      DO 100 I=3,IMAX
```

Appendix A-3. Computer Program for Plotting Doric Data.

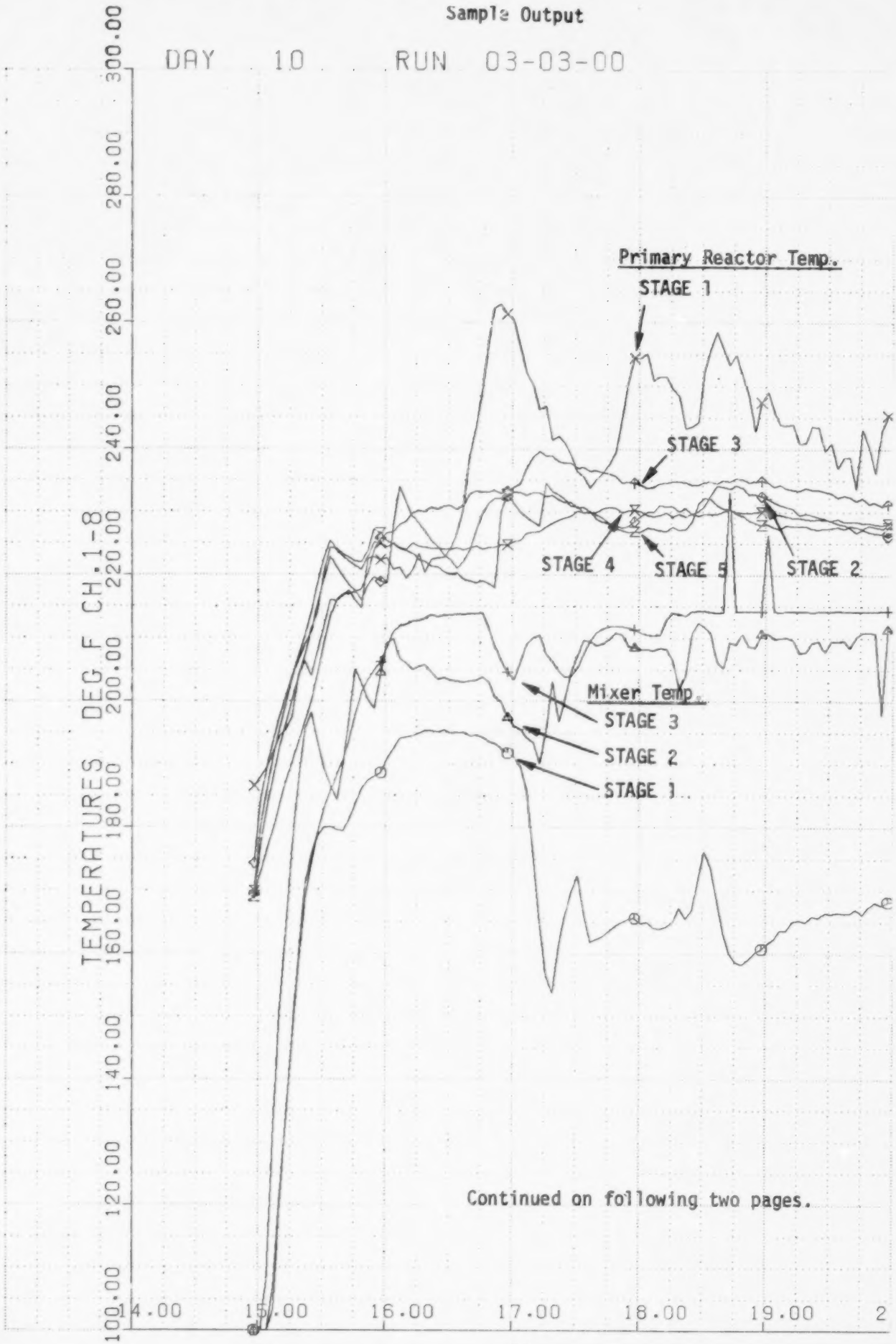
```
      DECODE(10,1100,DORIN(I)) ICHAN,SIGN,DATA,IEXP
 1100 FORMAT(1X,I2,R1,F5.0,I1)
      IF(ICHAN.EQ.90.OR.ICHAN.EQ.91.OR.ICHAN.EQ.99) GO TO 91
      IF(ICHAN.GT.IALCH) GO TO 100
   91 DO 92 J=1,NCHAN
      IF(ICHAN.EQ.NAMCH(J)) GO TO 94
   92 CONTINUE
      GO TO 100
   94 DATA=DATA*10.**(-IEXP)
      IF(SIGN.EQ.MINUS) DATA=0.
      IF(DATA.LT.YMIN) DATA=YMIN
      IF(DATA.GT.YMAX) DATA=YMAX
      PDATA(L,J)=DATA
      ISIG=ISIG+1
  100 CONTINUE
      IF(ISIG.LT.NCHAN) L=L-1
      GO TO 60
  180 IF(L.GT.0) CALL PLT
      CALL RDTIME
      GO TO 60
  185 L=L-1
      GO TO 60
      END
C
C
      SUBROUTINE RDTIME
      COMMON/A/DORIN(113),PDATA(900,8),TIME(800),
     1          D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2          NAMCH(8),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3          TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
      DIMENSION P(6400)
      EQUIVALENCE (PDATA,P)
C
      READ(6,1000) YTITLE
 1000 FORMAT(3A10)
      IF(EOF,6) 58,45
   45 ACCEPT(6) YMIN,YINCR
      YMAX=YMIN+10.*YINCR
      ACCEPT(6) ((D(I),H(I),M(I),S(I)),I=1,3)
      DAY=24.*D(1)
```

Appendix A-3. (Continued)

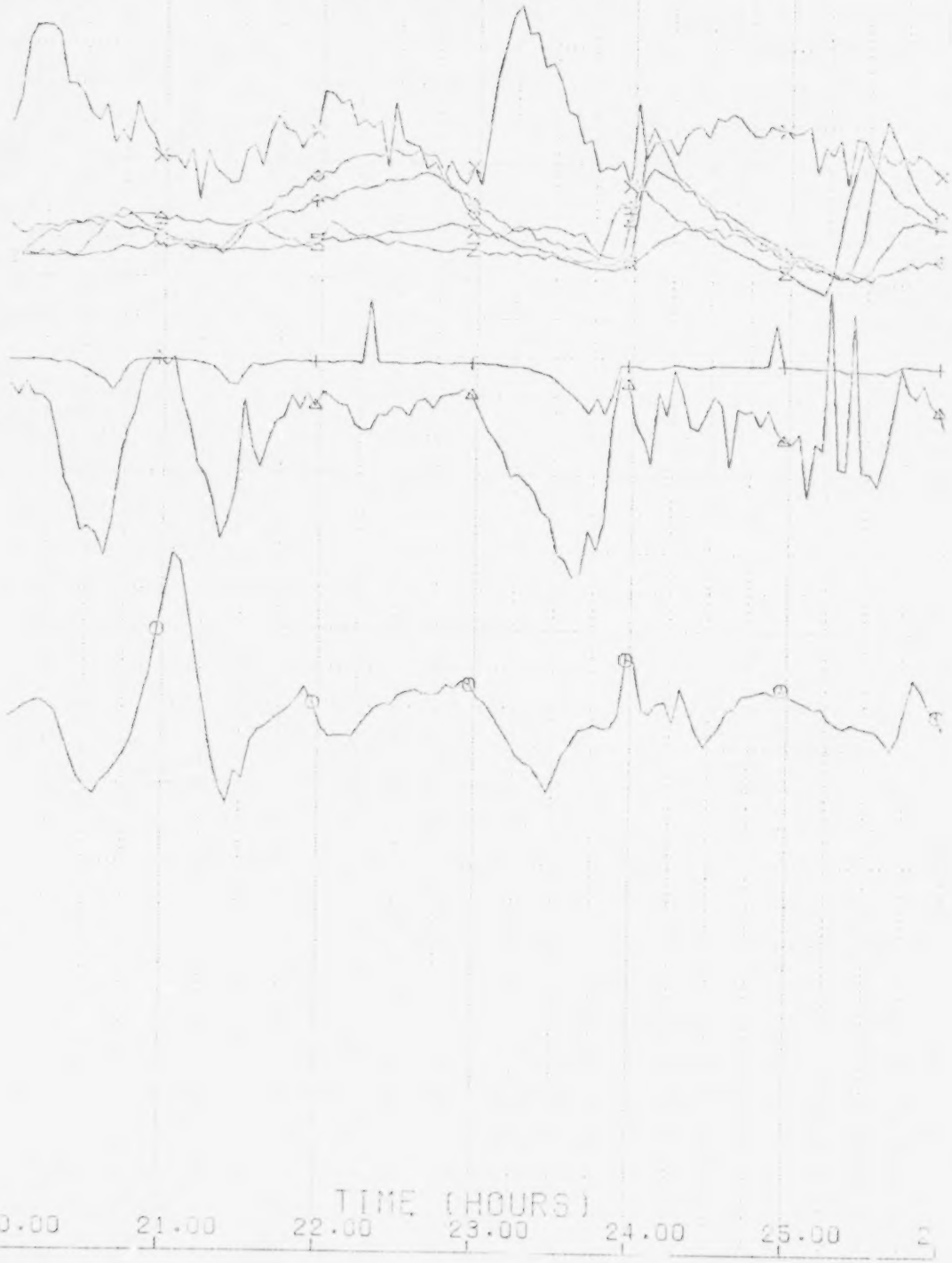
```
      DO 50 I=1,3
   50 T(I)=24.*D(I)+H(I)+M(I)/60.+S(I)/3600.
      XMIN=T(1)-DAY
      XINCR=1.
      ACCEPT(6) SKIP,NCHAN
      ACCEPT(6) (NAMCH(I),I=1,NCHAN)
      L=0
      DO 59 I=1,MAXP
   59 P(I)=-0.0
      REWIND 4
      IF(SKIP.LE.0) RETURN
      DO 55 I=1,SKIP
   55 READ(4)
      RETURN
   58 CALL PLOT(0.,0.,999)
      STOP
      END
C
C
C     PLOT
      SUBROUTINE PLT
      COMMON/A/DORIN(113),PDATA(900,8),TIME(800),
     1          D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2          NAMCH(8),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3          TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
  300 TIME(L+1)=XMIN
      TIME(L+2)=XINCR
      DO 310 I=1,NCHAN
      PDATA(L+1,I)=YMIN
      PDATA(L+2,I)=YINCR
  310 CONTINUE
C
      CALL AXIS(0,0,12HTIME (HOURS),12,XLNGTH,0.,TIME(L+1),TIME(L+2))
      CALL AXIS(0,0,YTITLE,30,10.,90.,PDATA(L+1,1),PDATA(L+2,1))
      ENCODE(10,3000,TITLE(1)) TITLE(1),D(1)
 3000 FORMAT(A7,F3.0)
      CALL SYMBOL(0.,10.,.14,TITLE,0.,30)
      DO 340 I=1,NCHAN
      CALL LINE(TIME,PDATA(1,I),L,1,20,I)
  340 CONTINUE



      CALL PLOT(XMOVE,0.,-3)
C
      RETURN
      END
```

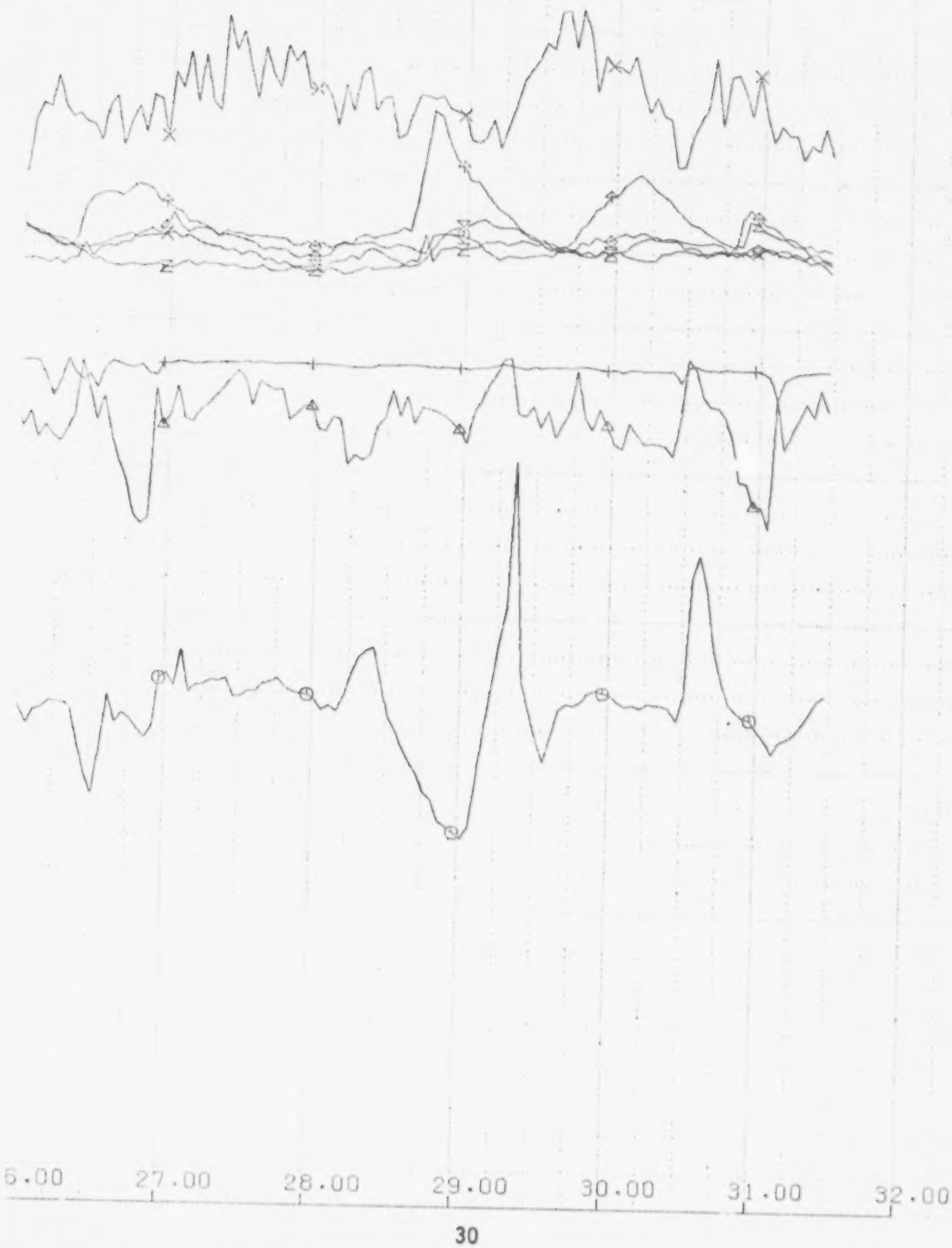
Appendix A-3. (Continued)

Sample Output



Continued on following two pages.


TIME (HOURS)
0.00
21.00
22.00
23.00
24.00
25.00


6.00
27.00
28.00
29.00
30.00
31.00
32.00

```
      PROGRAM DORAVG(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE4,
     1                TAPE5,TAPE6)
C
C     WRITTEN 1/5/78  DEBBIE HOPP  247360
C     GETS AVERAGES, STD.DEV. FOR ANY CHANNELS
C     T(1)=MIN,T(2)=MAX,T(3)=MIN TIME INTERVAL  (TAPE6)
C     TAPE4 IS OUTPUT FROM DORIC PROGRAM (CONVERTED DATALOGGER TAPE)
C
      COMMON/A/DORIN(113),PDATA(100),PAVG(100),PSQ(100),SIGMA(100),
     1         PLIM(100),
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2         NAMCH(100),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3         TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
      DATA NMAX/102/,MINUS/1R-/,IALCH/48/,MAXP/100/
      DATA TITLE/5H  DAY,8H      RUN/
      DATA PLIM/1000.,8*20.,2*1000.,2*1.,2*1000.,30.,4*1000.,50.,
     1          2*1000.,20.,2.,5*1000.,3*2.,67*1000./
C
      REWIND 4
      REWIND 6
      REWIND 5
      WRITE(5,1000)
 1000 FORMAT(1H1,3X,*DORIC AVERAGES AND STD. DEVIATIONS*)
      CALL RDTIME
C     READ MIN,MAX TIMES, MIN TIME INTERVAL
C
   60 READ(4) N,(DORIN(I),I=1,N)
      IF(EOF,4) 180,80
   80 DECODE(10,1080,DORIN(2)) D(4),H(4),M(4),S(4)
 1080 FORMAT(F3.0,1X,3F2.0)
      T(4)=24.*D(4)+H(4)+M(4)/60.+S(4)/3600.
   85 IF(T(4).LT.T(1))GO TO 60
      IF(T(4).GT.T(2)) GO TO 180
      IF(L.EQ.0) GO TO 90
      IF((T(4)-DAY-TIME).LT.T(3)) GO TO 60
   90 L=L+1
      TITLE(3)=DORIN(1)
      TIME=T(4)-DAY
      ISIG=0
      IMAX=MINO(N,NMAX)
```

Appendix A-4. Computer Program for Computing Averages and Standard Deviations of Doric Data Channels

```
      DO 100 I=3,IMAX
      DECODE(10,1100,DORIN(I)) ICHAN,SIGN,DATA,IEXP
 1100 FORMAT(1X,I2,R1,F5.0,I1)
      IF(ICHAN.EQ.90.OR.ICHAN.EQ.91.OR.ICHAN.EQ.99) GO TO 91
      IF(ICHAN.GT.IALCH) GO TO 100
   91 DO 92 J=1,NCHAN
      IF(ICHAN.EQ.NAMCH(J)) GO TO 94
   92 CONTINUE
      GO TO 100
   94 DATA=DATA*10.**(-IEXP)
      IF(SIGN.EQ.MINUS) DATA=0.
      IF(L.EQ.1) GO TO 96
      IF(ABS(DATA-PDATA(J)).GE.PLIM(ICHAN+1)) DATA=PDATA(J)
   96 PDATA(J)=DATA
      PAVG(J)=PAVG(J)+DATA
      PSQ(J)=PSQ(J)+DATA**2
      ISIG=ISIG+1
  100 CONTINUE
      GO TO 60
  180 IF(L.GT.0) CALL AVG
      CALL RDTIME
      GO TO 60
  185 L=L-1
      GO TO 60
      END
C
C
      SUBROUTINE RDTIME
      COMMON/A/DORIN(113),PDATA(100),PAVG(100),PSQ(100),SIGMA(100),
     1         PLIM(100),
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2         NAMCH(100),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3         TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
      ACCEPT(6) ((D(I),H(I),M(I),S(I)),I=1,3)
      IF(EOF,6) 58,45
   45 DAY=24.*D(1)
      DO 50 I=1,3
   50 T(I)=24.*D(I)+H(I)+M(I)/60.+S(I)/3600.
      ACCEPT(6) SKIP,NCHAN
      ACCEPT(6) (NAMCH(I),I=1,NCHAN)
```

Appendix A-4. (Continued)

```
      L=0
      DO 59 I=1,MAXP
      PAVG(I)=0.
   59 PSQ(I)=0.
      REWIND 4
      IF(SKIP.LE.0) RETURN
      DO 55 I=1,SKIP
   55 READ(4)
      RETURN
   56 STOP
      END
C
C
C     CALCULATE AVERAGES, STD.DEV.'S, PRINT
      SUBROUTINE AVG
      DIMENSION IT(8)
      COMMON/A/DORIN(113),PDATA(100),PAVG(100),PSQ(100),SIGMA(100),
     1         PLIM(100),
     1         D(4),H(4),M(4),S(4),T(4),NMAX,MINUS,L,MAXP,XLNGTH,
     2         NAMCH(100),NCHAN,YMIN,YINCR,YMAX,IALCH,SKIP,DAY,XMOVE,
     3         TITLE(3),YTITLE(3),XMIN,XINCR
      INTEGER SIGN,RUN,DORIN,SKIP,TITLE
      REAL M
      DO 310 J=1,NCHAN
      PAVG(J)=PAVG(J)/L
  310 SIGMA(J)=SQRT(ABS(PSQ(J)/L-PAVG(J)**2))
      DO 320 I=1,2
      J=4*I-3
      IT(J)=M(I)/10.
      IT(J+1)=AMOD(M(I),10.)
      IT(J+2)=S(I)/10.
  320 IT(J+3)=AMOD(S(I),10.)
      WRITE(5,1010) TITLE(3),D(1),H(1),(IT(I),I=1,4),D(2),H(2),(IT(I),
     1                  I=5,8)
      WRITE(5,1020)
      DO 330 J=1,NCHAN
      WRITE(5,1030) NAMCH(J),PAVG(J),SIGMA(J)
  330 CONTINUE
      RETURN
 1010 FORMAT(//4X,*RUN *,A10/4X,*DAY *,2F3.0,2(*:*,2I1),* TO DAY *,
     1       2F3.0,2(*:*,2I1))
 1020 FORMAT(4X,*CHANNEL*,4X,*AVERAGE*,4X,*STD.DEV.*)


 1030 FORMAT(7X,I2,5X,F7.1,4X,F8.2)
      END
```

Appendix A-4. (Continued)

Sample Output

DORIC AVERAGES AND STD. DEVIATIONS

RUN 03-04-00
DAY 11 7:31:00 TO DAY 11 13:00:00

CHANNEL	AVERAGE	STD.DEV.
1	169.0	6.06
2	205.6	3.69
3	214.0	.95
4	235.7	13.63
5	234.1	5.67
6	234.5	4.80
7	231.6	3.50
8	230.1	2.12
9	64.9	2.43
10	60.3	1.56
11	62.3	.67
12	65.1	.18
15	145.9	1.94
20	279.9	23.97
23	53.1	1.45
24	1.7	.45
30	1.3	.13
31	1.1	.21
32	1.9	.20

Appendix A-4. (Continued)

```
      PROGRAM RTUBAL(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE4,TAPE5,
     1               TAPE6)
C
C     WRITTEN 12/1/77 DEBBIE HOPP   247360 REVISED 1/23/78
C     MEYERS PROCESS MASS BALANCES
C     USES CONVERTED DATALOGGER TAPE AS INPUT (TAPE4)
C     NMAX=LAST CHANNEL NEEDED(34)+3
      COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      INTEGER SIGN,RUN,DORIN
      REAL M
      DATA IALCH/48/,NMAX/51/,MINUS/1R-/
      DATA CLIM/120.,220.,120.,220.,120.,220.,170.,280.,170.,280.,
     1     170.,280.,170.,280.,170.,280.,0.,0.,40.,100.,8*0.,
     2     -9999.,9999.,-9999.,9999.,-9999.,9999.,0.,100.,
     3     4*0.,15.,100.,2*0.,15.,100.,20*0.,0.,30.,0.,38.,
     4     16*0.,32.,212.,4*0.,180.,270.,32.,212./
C
      REWIND 4
      REWIND 5
      REWIND 6
      IBSP=0
      DISPLAY *ENTER TYPE OF RUN*
      DISPLAY *1=O2 BAL, 2=T-2 BAL, 3=R-1 BAL*
      ACCEPT IRUN
      GO TO (10,20,30),IRUN
   10 CALL O2BAL
      STOP
   20 CALL T2BAL
      STOP
   30 CALL R1BAL
      STOP
      END
C
C     ------------------------------------------------------------------
      SUBROUTINE O2BAL
C     O2 BALANCE (IN TO R-1, OUT OF V-1)
C     TAPE6 HAS NO.CELLS IN R-1,O2 PURITY, STARTING AND ENDING TIMES
      COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
```

Appendix A-5. Computer Program for T-2 and R-1 Material Balances.

```
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      DIMENSION ISTCH(20)
      INTEGER SIGN,RUN,DORIN
      REAL N
      DATA NS/10/,ISTCH/4,5,6,7,8,10,18,21,23,35/
      WRITE(5,1000)
 1000 FORMAT(1H1,8X,*RTU OXYGEN BALANCE*)
   55 ACCEPT (6) NCELL,PCO2
      IF(EOF,6) 199,58
   58 CALL RDTIME
      SN=NCELL
      ISTART=8-NCELL+1
      NR=NV=0
      RIN=VOUT=0.
      R=19.
      FL=2.95
C     GET VOL OF ONE CELL AT WEIR HEIGHT
      VOL1=CVOL(25.)
   60 CALL RDTAPE
      IF(IEND.EQ.1) GO TO 190
C
C
C     CHECK IF P,T WITHIN LIMITS (IF NOT,USE PREV., IF NO PREV.,DISCARD)
      DO 125 I=1,NS
      K=ISTCH(I)
      IF(K.LT.ISTART) GO TO 125
      IF(CHAN(K).GE.CLIM(1,K).AND.CHAN(K).LE.CLIM(2,K)) GO TO 125
      IF(IFIRST.EQ.0) GO TO 60
      CHAN(K)=OLD(K)
  125 CONTINUE
C
C     CALCULATE O2 IN, OUT (LEAVE OUT FIRST TIME PERIOD)
      IF(IFIRST.EQ.0) GO TO 142
      IF(CHAN(15).LE.0.) GO TO 130
      RIN=RIN+CHAN(15)*PCO2/100.
  130 NR=NR+1
      IF(CHAN(16).LE.0.) GO TO 140
      VOUT=VOUT+CHAN(16)*CHAN(19)/100.*(CHAN(23)+14.7-PH2O(CHAN(10)))
     1          /(CHAN(23)+14.7)
  140 NV=NV+1
 1099 FORMAT(*DATE=*,A10,5X,A10,5X,F14.8,5X,E14.8)
```

Appendix A-5. (Continued)

```
      GO TO 145
C
C     CALCULATE ACCUMULATION IF FIRST TIME
  142 VOL=CVOL(CHAN(35))
      IF(CHAN(35).GE.25.) GO TO 143
C     SLURRY LOWER THAN WEIR
      VOL=VOL+4.*VOL1
      GO TO 144
  143 VOL=5.*VOL
  144 RACC1=O2ACC(VOL)
C
C     STORE CHANNEL INFO AND TIMES
  145 CALL STORE(NS,ISTCH)
      GO TO 60
C
C     FINISHED THIS TIME SEGMENT
  190 WRITE(5,1010) RUN,D(1),H(1),(IT(I),I=2,5),D(3),H(3),(IT(I),I=6,9)
C     CALCULATE BALANCE
      IF(NR.EQ.0.OR.NV.EQ.0) GO TO 195
      TDELT=T(3)-T(1)
      RIN=32.*RIN*TDELT/(NR*387.)
      VOUT=32.*VOUT*TDELT/(NV*387.)
      VOL=CVOL(CHAN(35))
      IF(CHAN(35).GE.25.) GO TO 191
C     SLURRY LOWER THAN WEIR
      VOL=VOL+4.*VOL1
      GO TO 192
  191 VOL=5.*VOL
  192 RACC2=O2ACC(VOL)
      ACC=RACC2-RACC1
      ERROR=VOUT+ACC-RIN
      PCERR=ERROR*100./RIN
      WRITE(5,1020) RIN,VOUT,ACC,ERROR,PCERR
      GO TO 55
  195 WRITE(5,1030)
      GO TO 55
 1010 FORMAT(//4X,*RUN *,A10/4X,*DAY *,2F3.0,2(*:*,2I1),* TO DAY *,
     I       2F3.0,2(*:*,2I1))
 1020 FORMAT(4X,*O2 IN TO  R-1=*,F8.2,* LBS*/4X,*O2 OUT OF V-1=*,F8.2,
     1       * LBS*/4X,*ACCUM. IN R-1=*,F8.2,* LBS*/4X,*GAIN *,8X,*=*,
     2       F8.2,* LBS*/4X,*PERCENT GAIN =*,F7.1)
 1030 FORMAT(* O2 FLOW IS ZERO *)
```

Appendix A-5. (Continued)

```
  199 RETURN
      END
C
C
C
C     ------------------------------------------------------------------
      SUBROUTINE T2BAL
C     TAPE 6 HAS AR,TFER,TR,SS,AS,TFES
C                NUMBER OF FI ENTRIES FOLLOWING,DAY,HR,MIN,FI16,17,18,
C                 STARTING AND ENDING TIMES.
      COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      INTEGER SIGN,RUN,DORIN
      REAL M
      DIMENSION FI16(100),FI17(100),FI18(100),ISTCH(20)
      DATA NS/2/,ISTCH/3,34/
      R=15.
      FL=7.58
      WRITE(5,1001)
 1001 FORMAT(1H1,8X,*T-2 BALANCE*)
  203 ACCEPT(6) AR,TFER,TR,SS,AS,TFES
      IF(EOF,6) 299,205
  205 ACCEPT(6) NF
      DO 208 I=1,NF
      ACCEPT(6) D(3),H(3),M(3),FI16(I),FI17(I),FI18(I)
  208 FTIM(I)=24.*D(3)+H(3)+M(3)/60.
      RHOR=100./(((100.-AR-3.578*TFER)/62.248+AR/113.966)*(1.+.0003*
     1          (TR-77.))*7.48)
  210 CALL RDTIME
      N1=N2=N3=NOUT=0
      TIN1=TIN2=TIN3=TOUT=0.
      J=1
  215 CALL RDTAPE
      IF(IEND.EQ.1) GO TO 250
C
C     CHECK IF TEMP. WITHIN LIMITS
      DO 218 I=1,NS
      K=ISTCH(I)
      IF(CHAN(K).GE.CLIM(1,K).AND.CHAN(K).LE.CLIM(2,K)) GO TO 218
      IF(IFIRST.EQ.0) GO TO 215
```

Appendix A-5. (Continued)

```
      CHAN(K)=OLD(K)
  218 CONTINUE
      TS=CHAN(3)
      IF(IFIRST.EQ.0) GO TO 235
C     CALCULATE FLOWS (LEAVE OUT 1ST TIME PERIOD)
C     USE CORRECT FI16 TO 19
      CALL FI(J)
  225 IF(CHAN(20).LE.0.) GO TO 229
      TIN1=TIN1+CHAN(20)
  228 N1=N1+1
      IF(CHAN(30).LE.0.) GO TO 230
      TIN2=TIN2+CHAN(30)
  230 N2=N2+1
      TIN3=TIN3+FI16(J)*.65+(FI17(J)+FI18(J))*.139
      N3=N3+1
      IF(CHAN(24).LE.0.) GO TO 232
      TOUT=TOUT+CHAN(24)*RHOSF(SS,AS,TFES,TS)
  232 NOUT=NOUT+1
      GO TO 240
C
C     CALCULATE T-2 VOLUME IF 1ST TIME
  235 IF(CHAN(34).GE.14.) GO TO 236
C     SLURRY LOWER THAN WEIR,  CHG. CALC.
      TACC1=(2.*CVOL(14.)+CVOL(CHAN(34)))/3.*RHOSF(SS,AS,TFES,TS)
      GO TO 240
  236 TACC1=CVOL(CHAN(34))*RHOSF(SS,AS,TFES,TS)
C
C     STORE CHANNEL INFO AND TIMES
  240 CALL STORE(NS,ISTCH)
      GO TO 215
C
C     FINISHED THIS TIME SEGMENT
  250 WRITE(5,1011) RUN,D(1),H(1),(IT(I),I=2,5),D(3),H(3),(IT(I),I=6,9)
C     CALCULATE BALANCE
      IF(N1.EQ.0.OR.N2.EQ.0.OR.N3.EQ.0.OR.NOUT.EQ.0) GO TO 260
      TDELT=T(3)-T(1)
      TIN1=TIN1*TDELT/N1
      TIN2=TIN2*RHOR*60.*TDELT/N2
      TIN3=TIN3*TDELT/N3
      TOUT=TOUT*.90*60.*TDELT/(NOUT*7.481)
      IF(CHAN(34).GE.14.) GO TO 255
C     SLURRY LOWER THAN WEIR
```

Appendix A-5. (Continued)

```
      TACC2=(2.*CVOL(14.)+CVOL(CHAN(34)))/3.*RHOSF(SS,AS,TFES,TS)
      GO TO 256
  255 TACC2=CVOL(CHAN(34))*RHOSF(SS,AS,TFES,TS)
  256 ACC=TACC2-TACC1
      ERROR=TOUT+ACC-TIN1-TIN2-TIN3
      PCERR=ERROR*100./(TIN1+TIN2+TIN3)
      WRITE(5,1021) TIN1,TIN2,TIN3,TOUT,ACC,ERROR,PCERR
      GO TO 203
  260 WRITE(5,1031)
      GO TO 203
C
 1011 FORMAT(//4X,*RUN *,A10/4X,*DAY *,2F3.0,2(*-*,2I1),* TO DAY *,
     1       2F3.0,2(*-*,2I1))
 1021 FORMAT(4X,*COAL  IN TO T-2=*,F8.2,* LBS*/
     1       4X,*LEACH IN TO T-2=*,F8.2,* LBS*/
     2       4X,*STEAM IN TO T-2=*,F8.2,* LBS*/
     3       4X,*SLURRY OUT     =*,F8.2,* LBS*/
     4       4X,*ACCUMUL. IN T-2=*,F8.2,* LBS*/
     5       4X,*GAIN *,10X,*=*,F8.2,* LBS*/
     6       4X,*PERCENT GAIN   =*,F7.1)
 1031 FORMAT(* FLOW IS ZERO*)
  299 STOP
      END
C
C
C
C     ------------------------------------------------------------------
      SUBROUTINE RIBAL
C     TAPE6  HAS NO. CELLS IN R-1,PCO2,
C            SS,AS,TFES,S2,AS2,TFES2,H2OM,CPH2O,CPR,CPC,
C            NO. OF FI ENTRIES FOLLOWING, DAY,HR,MIN,FI67,68,69,90,71
C                ,STARTING AND ENDING TIMES.
      COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,RMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      INTEGER SIGN,RUN,DORIN
      REAL M
      DIMENSION FI67(100),FI68(100),FI69(100),FI90(100),FI71(100),
     1          ISTCH(20)
      DATA NS/13/,ISTCH/3,4,5,6,7,8,10,18,21,23,35,44,48/
      R=19.
```

Appendix A-5. (Continued)

```
      FL=2.95
      WRITE(5,1002)
 1002 FORMAT(1H1,8X,*R-1 BALANCE*)
  310 ACCEPT(6) NCELL,PC02
      IF(EOF,6) 399,315
  315 ACCEPT(6) SS,AS,TFES,S2,AS2,TFES2
      ACCEPT(6) H2OM,CPH2O,CPR,CPC
      ACCEPT(6) NF
      DO 318 I=1,NF
      ACCEPT(6) D(3),H(3),M(3),FI67(I),FI68(I),FI69(I),FI90(I),FI71(I)
  318 FTIM(I)=24.*D(3)+H(3)+M(3)/60.
      SN=NCELL
      ISTART=9-NCELL
      FACTOR=H2OM*CPH2O*100./(CPR*(100.-S2)+CPC*S2)
C     GET VOL OF ONE CELL AT WEIR HEIGHT
      VOL1=CVOL(25.)
  320 CALL RDTIME
      N1=N2=N3=0
      NO1=NO2=NO3=0
      RIN1=RIN2=RIN3=0.
      RO1=RO2=RO3=RO4=0.
      J=1
  322 CALL RDTAPE
      IF(IEND.EQ.1) GO TO 350
C     CHECK IF P,T WITHIN LIMITS
      DO 325 I=1,NS
      K=ISTCH(I)
      IF(K.GT.3.AND.K.LT.ISTART) GO TO 325
      IF(CHAN(K).GE.CLIM(1,K).AND.CHAN(K).LE.CLIM(2,K)) GO TO 325
      IF(IFIRST.EQ.0) GO TO 322
      CHAN(K)=OLD(K)
  325 CONTINUE
      TS=CHAN(3)
      IF(IFIRST.EQ.0) GO TO 335
C     CALCULATE FLOWS (LEAVE OUT 1ST TIME PERIOD)
C     USE CORRECT FI67-69,90,71 - GET INDEX J
      CALL FI(J)
      IF(CHAN(24).LE.0.) GO TO 330
      RIN1=RIN1+CHAN(24)*R40SF(SS,AS,TFES,TS)
  330 N1=N1+1
      RIN2=RIN2+.33*(FI67(J)+FI69(J))+.099*(FI68(J)+FI90(J)+FI71(J))
      N2=N2+1
```

Appendix A-5. (Continued)

```
      IF(CHAN(15).LE.0.) GO TO 331
      RIN3=RIN3+CHAN(15)
  331 N3=N3+1
      RO1=RO1+(CHAN(48)-CHAN(44))/(CHAN(8)-212.)
      RO4=RO4+(CHAN(48)-CHAN(44))*(CHAN(8)-212.)
      NO1=NO1+1
      IF(CHAN(16).LE.0.) GO TO 332
      RO2=RO2+CHAN(16)*CHAN(18)*(CHAN(23)+14.7-PH2O(CHAN(10)))/
     1     (CHAN(23)+14.7)
      RO3=RO3+CHAN(16)*PH2O(CHAN(10))/(CHAN(23)+14.7)
  332 NO2=NO2+1
      NO3=NO3+1
      GO TO 340
C
C     CALCULATE LB. ACCUM. IF 1ST TIME
  335 VOL=CVOL(CHAN(35))
      IF(CHAN(35).GE.25.) GO TO 337
C     SLURRY LOWER THAN WEIR
      VOL=VOL+4.*VOL1
      GO TO 338
  337 VOL=VOL*5.
  338 OACC1=O2ACC(VOL)
      RACC1=VOL*RHOSF(S2,AS2,TEFS2,CHAN(8))
C     STORE CHANNEL INFO AND TIMES
  340 CALL STORE(NS,ISTCH)
      GO TO 322
C
C     FINISHED THIS TIME SEGMENT
  350 WRITE(5,1012) RUN,D(1),H(1),(IT(I),I=2,5),D(3),H(3),(IT(I),I=6,9)
C     CALCULATE BALANCE
      IF(N1.EQ.0.OR.N2.EQ.0.OR.N3.EQ.0.OR.NO1.EQ.0.OR.NO2.EQ.0
     1   .OR.NO3.EQ.0) GO TO 360
      TDELT=T(3)-T(1)
      RIN1=RIN1*.90*60.*TDELT/(7.491*N1)
      RIN2=RIN2*TDELT/N2
      RIN3=RIN3*PCO2*32.*TDELT/(387.*100.*N3)
      RO1=(RO1*FACTOR-RO4*420M/1000.)*TDELT/NO1
      RO2=RO2*32.*TDELT/(387.*100.*NO2)
      RO3=RO3*18.016*TDELT/(387.*NO3)
      VOL=CVOL(CHAN(35))
      IF(CHAN(35).GE.25.) GO TO 355
C     SLURRY LOWER THAN WEIR
```

Appendix A-5. (Continued)

```
      VOL=VOL+4.*VOL1
      GO TO 357
  355 VOL=5.*VOL
  357 OACC2=O2ACC(VOL)
      RACC2=VOL*RHOSF(S2,AS2,TFFS2,CHAN(8))
      ACCO=OACC2-OACC1
      ACCR=RACC2-RACC1
      ERROR=RO1+RO2+RO3+ACCO+ACCR-RIN1-RIN2-RIN3
      PCERR=ERROR*100./(RIN1+RIN2+RIN3)
      WRITE(5,1022) RIN1,RIN2,RIN3,RO1,RO2,RO3,ACCO,ACCR,ERROR,PCERR
      GO TO 310
  360 WRITE(5,1032)
      GO TO 310
C
 1012 FORMAT(//4X,*RUN *,A10/4X,*DAY *,2F3.0,2(*:*,2I1),* TO DAY *,
     1        2F3.0,2(*:*,2I1))
 1022 FORMAT(4X,*SLURRY  IN TO R-1=*,F8.2,* LBS*/
     1        4X,*STEAM   IN TO R-1=*,F8.2,* LBS*/
     2        4X,*O2      IN TO R-1=*,F8.2,* LBS*/
     3        4X,*SLURRY OUT OF R-1=*,F8.2,* LBS*/
     4        4X,*O2     OUT OF R-1=*,F8.2,* LBS*/
     5        4X,*STEAM  OUT OF R-1=*,F8.2,* LBS*/
     6        4X,*O2       ACCUMUL.=*,F8.2,* LBS*/
     7        4X,*SLURRY   ACCUMUL.=*,F8.2,* LBS*/
     8        4X,*GAIN             =*,F8.2,* LBS*/
     9        4X,*PERCENT GAIN     =*,F7.1)
 1032 FORMAT(* FLOW IS ZERO*)
  398 STOP
      END
C
C
C
C     ------------------------------------------------------------------
      SUBROUTINE RDTIME
C     READ BEGIN AND END TIMES
      COMMON/AA/DDRIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),I8SP
      INTEGER SIGN,RUN,DDRIN
      REAL M
  300 ACCEPT(6) ((D(I),H(I),M(I),S(I)),I=1,2)
```

Appendix A-5. (Continued)

```
      IF(EOF,6) 399,305
  305 DO 308 I=1,2
  308 T(I)=24.*D(I)+H(I)+M(I)/60.+S(I)/3600.
      IFIRST=0
      IF(IBSP.EQ.0) GO TO 309
      BACKSPACE 4
      BACKSPACE 4
  309 IBSP=1
      RETURN
  399 STOP
      END
C
C
C
C     ------------------------------------------------------------------
      SUBROUTINE RDTAPE
      COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      INTEGER SIGN,RUN,DORIN
      REAL M
      IEND=1
   65 READ(4) N,(DORIN(I),I=1,N)
      IF(EOF,4) 105,70
   70 DECODE(10,1070,DORIN(2)) D(4),H(4),M(4),S(4)
 1070 FORMAT(F3.0,1X,3F2.0)
      T(4)=24.*D(4)+H(4)+M(4)/60.+S(4)/3600.
      IF(T(4).LT.T(1)) GO TO 65
      IF(T(4).GT.T(2)) GO TO 105
C     WITHIN TIME LIMITS, DECODE CHAN.1 TO N
      IMAX=MIN0(N,NMAX)
      DO 100 I=4,IMAX
      DECODE(10,1100,DORIN(I)) ICHAN,SIGN,DATA,IEXP
 1100 FORMAT(1X,I2,R1,F5.0,I1)
      CHAN(ICHAN)=DATA*10.**(-IEXP)
      IF(SIGN.EQ.MINUS) CHAN(ICHAN)=0.
  100 CONTINUE
      IEND=0
      RETURN
C
C     FINISHED THIS TIME SEGMENT
```

Appendix A-5. (Continued)

```
C       CONVERT TIMES TO PRINT
  105 DO 108 I=1,3,2
      J=2*I
      IT(J)=M(I)/10.
      IT(J+1)=AMOD(M(I),10.)
      IT(J+2)=S(I)/10.
  108 IT(J+3)=AMOD(S(I),10.)
      RETURN
      END
C
C
C
C       ------------------------------------------------------------
      SUBROUTINE FI(J)
C     FIND INDEX FOR CURRENT TIME IN FI ARRAYS
      COMMON/AA/DDRIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      IF(J.EQ.NF) GO TO 224
      J1=J+1
      DO 220 JJ=J1,NF
      IF(FTIM(JJ).GT.T(4)) GO TO 223
  220 CONTINUE
      J=NF
      GO TO 224
  223 J=JJ-1
  224 RETURN
      END
C
C
C       ------------------------------------------------------------
      SUBROUTINE STORE(NS,ISTCH)
C     STORE CHANNEL INFO AND TIMES
      COMMON/AA/DDRIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLIM(2,100),IBSP
      DIMENSION ISTCH(20)
      INTEGER SIGN,RUN,DDRIN
      REAL M
      IF(NS.EQ.0) GO TO 155
```

Appendix A-5. (Continued)

```
      DO 150 I=1,NS
      J=ISTCH(I)
  150 OLD(J)=CHAN(J)
  155 D(3)=D(4)
      H(3)=H(4)
      M(3)=M(4)
      S(3)=S(4)
      T(3)=T(4)
      IF(IFIRST.NE.0) RETURN
      D(1)=D(4)
      H(1)=H(4)
      M(1)=M(4)
      S(1)=S(4)
      T(1)=T(4)
      RUN=DORIN(1)
      IFIRST=1
      RETURN
      END
C
C
C
C     ---------------------------------------------------------------
      FUNCTION PH2O(TF)
C     TEMP MUST BE BETWEEN 40-100F, OR 170-280F
      DIMENSION PTABL(100,2),FACTOR(2),TMIN(2)
      DATA FACTOR/1.,2./,TMIN/40.,170./
      DATA(PTABL(I),I=1,61)/
     1.1217,.1265,.1315,.1367,.1420,.1475,.1532,.1591,.1653,.1716,.1781,
     2 .1849,.1918,.1990,.2064,.2141,.2220,.2302,.2386,.2473,.2563,
     3 .2655,.2751,.2850,.2951,.3056,.3164,.3276,.3390,.3509,.3631,
     4 .3756,.3886,.4019,.4156,.4298,.4443,.4593,.4747,.4906,.5069,
     5 .5237,.5410,.5588,.5771,.5959,.6152,.6351,.6556,.6766,.6982,
     6 .7204,.7432,.7666,.7906,.8153,.8407,.8668,.8935,.9210,.9492/
      DATA (PTABL(I),I=101,157)/
     1 5.992,6.273,6.565,6.868,7.183,7.510,7.850,8.202,8.567,8.946,
     1 9.3339,9.746,10.168,10.605,11.058,
     2 11.526,12.011,12.512,13.031,13.568,14.123,14.696,15.289,15.901,
     3 16.533,17.186,   17.861,18.557,19.275,20.016,20.780,21.567,
     4 22.379,23.217,24.080,24.969,   25.884,26.827,27.798,28.797,
     5 29.825,30.884,31.973,33.093,34.245,35.429,   36.646,37.897,
     6 39.182,40.502,41.858,43.252,44.682,46.150,47.657,49.203/
C
```

Appendix A-5. (Continued)

```
      J=1
      IF(TF.GE.200.) J=2
      I=(TF-TMIN(J))/FACTOR(J)
      FRAC=(TF-TMIN(J)-I*FACTOR(J))/FACTOR(J)
      PH2O=PTABL(I+1,J)+FRAC*(PTABL(I+2,J)-PTABL(I+1,J))
      RETURN
      END
C
C
C     ------------------------------------------------------------
      FUNCTION RHOSF(SS,AS,TFES,TS)
C     CALCULATE RHO(S) IN LB/CU.FT
      RHOSF=(100.+SS/(1.-.01*SS))/(((100.-AS-3.978*TFES)/62.248+AS/
     1                113.966)*(1.+.0003*(TS-77.))+SS/(84*(1.-.01*SS)))
      RETURN
      END
C
C
C
C     ------------------------------------------------------------------
      FUNCTION CVOL(HT)
C     CALCULATE CU.FT. OF LIQUID(DEPTH HT IN.) IN CYL.TANK(RADIUS R IN.,
C                LENGTH FL FT.)
      COMMON/AA/DORIN(102),C4AN(100),QLD(100),Q(4),H(4),M(4),S(4),T(4),
     1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
     2          RHOR,RHOS,NMAX,AR,TFLR,TR,SS,AS,TFES,TS,R,FL,RUN,
     3          FTIM(100),NF,CLTM(2,100),IdSP
      DATA PI/3.1416/
      IF(HT-R) 270,280,290
  270 A=R**2*ACOS((R-HT)/R)-(R-HT)*SQRT(2.*R*HT-HT**2)
      GO TO 295
  280 A=R**2*PI/2.
      GO TO 295
  290 A=R**2*(PI-ACOS((HT-R)/R))-(R-HT)*SQRT(2.*R*HT-HT**2)
  295 CVOL=A/144.*FL
      RETURN
      END
C
C
C
C     ------------------------------------------------------------
      FUNCTION O2ACC(VOL)
```

Appendix A-5. (Continued)

```
C      CALC. O2 ACCUM AT R-1 IN LB
       COMMON/AA/DORIN(102),CHAN(100),OLD(100),D(4),H(4),M(4),S(4),T(4),
      1          MINUS,IFIRST,N,NCELL,PCO2,SN,ISTART,IT(8),IALCH,IEND,
      2          RHOR,RHOS,NMAX,AR,TFER,TR,SS,AS,TFES,TS,R,FL,RUN,
      3          FTIM(100),NF,CLIM(2,100),IBSP
       PSIA=CHAN(21)+14.7
       TAVG=0.
       DO 410 I=ISTART,8
  410  TAVG=TAVG+CHAN(I)
       TAVG=TAVG/SN
       O2ACC=(115.38-VOL)*32./387.*CHAN(18)*(PSIA-PH2O(TAVG))*520.
      1      /(100.*14.7*(TAVG+460.))
       RETURN
       END
```

Appendix A-5. (Continued)

48

Sample Output

R-1 BALANCE

```
RUN 03-03-00
DAY  11   7:28:00 TO DAY  11 10:52:00
SLURRY   IN TO R-1= 2971.22 LBS
STEAM    IN TO R-1=  738.50 LBS
02       IN TO R-1=   20.98 LBS
SLURRY OUT OF R-1= 2653.25 LBS
02      OUT OF R-1=   11.76 LBS
STEAM   OUT OF R-1=     .03 LBS
02        ACCUMUL.=     .86 LBS
SLURRY    ACCUMUL.=    1.05 LBS
GAIN               = -663.76 LBS
PERCENT GAIN       =  -23.2
```

```
RUN 03-04-00
DAY  11 11:01:00 TO DAY  11 12:58:00
SLURRY   IN TO R-1= 1502.77 LBS
STEAM    IN TO R-1=  423.55 LBS
02       IN TO R-1=   11.39 LBS
SLURRY OUT OF R-1=  940.26 LBS
02      OUT OF R-1=   14.59 LBS
STEAM   OUT OF R-1=     .04 LBS
02        ACCUMUL.=     .31 LBS
SLURRY    ACCUMUL.=    3.64 LBS
GAIN               = -978.66 LBS
PERCENT GAIN       =  -50.5
```

T-2 BALANCE

```
RUN 03-03-00
DAY  11 17:10:00 TO DAY  11  7:28:00
COAL   IN TO T-2= [illegible] LBS
LEACH  IN TO T-2= 1313.39 LBS
STEAM  IN TO T-2= 1012.41 LBS
SLURRY OUT      =[illegible] LBS
ACCUMUL. IN T-2=   [illegible] LBS
GAIN               = 1333.[illegible] LBS
PERCENT GAIN       =   [illegible]
```

BTU OXYGEN BALANCE

```
RUN 03-03-00
DAY  11   7:28:00 TO DAY  11 12:58:00
02 IN TO  R-1=   33.25 LBS
02 OUT OF R-1=   28.31 LBS
ACCUM. IN R-1=     .71 LBS
GAIN           =  -4.23 LBS
PERCENT GAIN =  -12.8
```

Appendix A-5. (Continued)

```
      PROGRAM YRTU(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE3)
C     WRITTEN 11/17/77  D.HOPP  (FROM TRWRTU(LVN), WTEST(DSH))
C     CALCULATES WPF AND Y FOR N STAGES GIVEN WPO AND YO,
C      WITH OR WITHOUT REGENERATION WITH O2
C     INPUT IS TAPE3, NAMELIST FORMAT(CHANGES INPUT FROM TERMINAL)
C
      COMMON/AA/N,AL,AR(100),FL,FR,PO2,PFCOAL,Y,WP,WPO(5),AWT(10),
     1 ANAM(10),X(100,5),W(100,5),TK,TF(100),TAU(100),TFE,FE2,F
      NAMELIST/PARAM/N,AL,AR,FL,FR,PO2,SP,R,TFE0,FE20,ACID,COAL,TF,TAU,F
      DATA ANAM/10HWATER     ,10HFESO4     ,10HFE(SO4)1.5,10HH2SO4     ,
     1          10HPYRITE    ,10HSULFUR    ,10HFE        /,
     2     AWT/18.016,151.914,199.949,98.082,119.982,32.066,55.847/
C
      REWIND 3
   30 READ(3,PARAM)
   35 DISPLAY *ENTER CHANGES, THENS*
      READ(1,PARAM)
C
C     INITIALIZE PARAMETERS W(WT IN LBS), X(LB-MOLES)
      WPO(1)=SP*AWT(5)/(2.*AWT(6))
      PFCOAL=COAL*(1.-WPO(1)/100.)
      TFE=TFE0*P/100.
      FE2=FE20*R/100.
      W(1,2)=FE2*AWT(2)/AWT(7)
      W(1,3)=(TFE-FE2)*AWT(3)/AWT(7)
      W(1,4)=ACID*R/100.
      W(1,1)=R-W(1,2)-W(1,3)-W(1,4)
      W(1,5)=COAL-PFCOAL
      DO 40 J=1,5
   40 X(1,J)=W(1,J)/AWT(J)
      WPO(5)=WPO(4)=WPO(3)=WPO(2)=WPO(1)
      Y=(TFE-FE2)/TFE
C
      YSUM=0.
      SN=N
      DO 50 I=1,N
      CALL WPSTAGE(I)
      YSUM=YSUM+Y
      DISPLAY *STAGE=*,I,*AVG WPF=*,WP,*   Y=*,Y
   50 CONTINUE
      YSUM=YSUM/SN
      DISPLAY *AVG Y=  *,YSUM
```

Appendix A-6. Typical Computer Program for Evaluation of RTU Kinetics.

```
      DISPLAY *ENTER 0 IF DONE,1 IF NEW CASE*
      ACCEPT INEXT
      IF(INEXT.NE.0) GO TO 35
   60 STOP
      END
C
C
C     ------------------------------------------------------------------
      SUBROUTINE WPSTAGE(TT)
C     REACTS 5 GROUPS OF COAL FOR THEIR STATISTICAL
C     RESIDENCE TIME (100 TIME INCREMENTS) THEN ITERATES
C     FOR Y (WITH REGEN IF POP.GT.1E-6).  THE 500
C     COAL FRACTIONS ARE ORDERED AND REGROUPED IN 5 BLOCKS.
C
      COMMON/AA/N,AL,AP(100),EL,ER,POP,PFCOAL,Y,WP,WP0(5),AWT(10),
     1 ANAM(10),X(100,5),W(100,5),TK,TF(100),TAU(100),TFE,FE2,F
      DIMENSION WPF(100,5),DM(5)
      DATA DX/.01/,NS/100/
C
C     CONVERT DEG F TO DEG K
      TK=(TF(II)+459.7)/1.8
      LOOP=0
   80 WP=0.
      LOOP=LOOP+1
      DO 100 J=1,5
      C1=Y**2*WP0(J)*TAU(TT)*DYDATE(AL,EL,TK)
      TDELT0=0.
      FRAC=DX
      DO 100 I=1,NS
      IF(I.EQ.100) FRAC=.9999
      TDELT1=-ALOG(1.-FRAC)
      TDELT=(TDELT0+TDELT1)/2.
      WPF(I,J)=WP0(J)/(1.+C1*TDELT)
      FRAC=FRAC+DX
      WP=WP+WPF(I,J)
  100 TDELT0=TDELT1
      WP=WP/500.
C
C     CALC. NEW PARAM
      PYM=WP/(100.-WP)*PFCOAL/AWT(5)
      DPYM=X(II,5)-PYM
      DFE2M=10.2*DPYM*F
```

Appendix A-6. (Continued)

```
      FETOTM=X(II,2)+X(II,3)+DPYM
      IF(PO2.GE.1.E-6) GO TO 120
      Y1=(X(II,3)-9.2*DPYM*F)/FETOTM
      IF(Y1.LT.0.) Y1=0.
      IF(ABS(Y-Y1).LT.1.E-6) GO TO 130
      IF(LOOP.GT.150) GO TO 126
      Y=(Y+Y1)/2.
      GO TO 80
C
C     THE ABOVE CONVERGES Y IF NO O2 OR FINDS
C     AMT OF REACTION IF O2 IS PRESENT
C     NEXT FINDS Y IF O2 PRESENT
C
  120 DFE2R=PO2*TAU(II)*((1.-Y1*FETOTM)**2/
     1       VOLUM(II)*RXRATE(AR(IT),ER,TK)
      Y1=1.-((X(II,2)+DFE2M-DFE2R)/FETOTM)
      IF(ABS(Y1-Y).LT.1E-6) GO TO 130
      IF(LOOP.GT.100) GO TO 128
      IF(Y1.GE.1.) GO TO 122
      IF(Y1.LE.0.) GO TO 124
      Y=(9.*Y+Y1)/10.
      GO TO 80
  122 Y=.9*Y+.1
      GO TO 80
  124 Y=.9*Y
      GO TO 80
  126 DISPLAY *NO O2, LOOP EXIT*
      GO TO 130
  128 DISPLAY *WITH O2, LOOP EXIT*
      PRINT 1280,Y,Y1
 1280 FORMAT( *Y=*F9.6*   Y1=*F9.6)
C
C     ABOVE FOUND Y FOR SIMULTANEOUS LEACH/REGEN.
C     NOW SORT 500 COAL FRACTIONS IN ASCENDING
C     ORDER AND RECOLLECT IN 5 GROUPS
C
  130 CALL SORT(WPF,1,500)
      DO 200 J=1,5
      WPO(J)=0.
      DO 150 I=1,NS
  150 WPO(J)=WPO(J)+WPF(I,J)
  200 WPO(J)=WPO(J)/100.
```

Appendix A-6. (Continued)

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```
C
C     CALCULATE CHANGE IN STREAM COMPOSITION
      DM(5)=-(DPYR)
      DM(1)=DM(5)*4.8
      DM(3)=-DM(1)
      DM(2)=DFE2R
      DM(3)=DM(5)*0.2*F
      IF(PO2.LT.1E-6) GO TO 210
      DM(1)=DM(1)+.5*DFE2R
      DM(2)=DM(2)-DFE2R
      DM(3)=DM(3)+DFE2R
      DM(4)=DM(4)-.5*DFE2R
  210 DO 220 J=1,5
      X(II+1,J)=X(II,J)+DM(J)
  220 W(II+1,J)=X(II+1,J)*AWT(J)
      RETURN
      END
C
C
C     ------------------------------------------------------
      FUNCTION RXRATE(A,E,TK)
C     USES AR,ER FOR REGEN
C     E(CAL)   A(CU.FT/LB MOL-PSIA-HR)
C     RETURNS REGEN OR LEACH RATE CONST (CU.FT./LB MOL-PSIA-HR)
C
      RXRATE=A*EXP(-E/(1.987*TK))
      RETURN
      END
C
C
C     ------------------------------------------------------
      FUNCTION VOLUN(I)
      COMMON/AA/H,AL,AR(100),EL,ER,PO2,PFCBAL,Y,WP,WPO(5),AWT(10),
     1 ANAM(10),X(100,5),W(100,5),TK,TF(100),TAU(100),TFE,FE2,F
      DATA DB/62.246/,DSA/113.9667
C
C     CALCULATES VOLUME OF STRAM I AT T,F USING
C     D25 N2O=.99708, D25 N2SO4=1.8255 G/CC
C     TEMP COEFF=-0.03 PCT/DEGF (VOL IN CUFT)
C
   20 T=(F*1.8)+32.
      V=W(I,1)/DB+W(I,4)/DSA
      VOLUN=V*(1.+.0003*T)
      RETURN
      END
```

Appendix A-6. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,H3,H4,H5,H6,A,B,C,D,H7
16 STRING T1,T2,T3,T4,T5,T6,T7,T8,T9,I,I1,I2,I3,I4,I5,I6,I7
17 STRING I8,I9,J,J1,J2,J3,J4,J5,J6,J7,J8,J9,K4,K5,K6,K7,K8,K9
20 PRINT "OUTPUT FILE NAME"
25 INPUT H6
30 OPEN H6,OUTPUT,5
32 GOTO 1000
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEETS DATA FROM ITEMS"
46 PRINT "1,2,4,5,8,9,11,12,14,15,18,19,21,22,26,27,29,30,31"
55 INPUT  E,F,M,N,O,P,Q,R  ,U,V,W,X,Y,Z,Z1,K,K1,K2
56 GOTO 200
60 F1=E-F
65 N1=M-N
70 N2=F1-N1
75 P1=O-P
80 R1=Q-R
85 U1=S-U
90 U2=U1-(N1+R1)
95 W1=V-W
100 Y1=X-Y
105 Y2=W1-Y1
110 Y3=Y2/W1*100
115 Z2=Z-Z1
120 K3=K1-K2
125 L1=((K3*(K/100))/Z2)*100
130 L2=((P1/W1*Y1)/(F1-N1))*100
135 L3=(U1/(F1-P1+R1))*(U1/(U1-N1-R1))
140 GOTO 700
200 FZ="$$$ ZB ZO$ /"
205 F3="$45$ ZB 4$.2$ /"
210 F4="$45$ 9B  4$.2$ /"
215 F5="$45$ 16B 4$.2$ /"
217 WRITE ON 5:"TEST PROCEDURE MY-01T-07"
218 WRITE ON 5:
220 H1="EXPERIMENT NO.:"
225 H2="SAMPLING LOCATION:"
230 H3="SAMPLING DATE:"
235 H4="SAMPLING TIME:"
240 T1=" (1) SAMPLE JAR, SAMPLE AND WASH WATER"
```

Appendix A-7. Computer Program for Reducing Control Laboratory Analytical Data.

```
245 T2=# (2) SAMPLE JAR#
250 T3=# (3) SAMPLE AND WASH WATER#
255 T4=# (4) INTITAL WASH WATER BOTTLE#
260 T5=# (5) FINAL WASH WATER BOTTLE#
265 T6=# (6) WASH WATER USED#
270 T7=# (7) SAMPLE (3) - (6)#
275 T8=# (8) BUCHNER FUNNEL AND COAL CAKE#
280 T9=# (9) BUCHNER FUNNEL#
285 I=#(10) COAL CAKE (WET)#
290 I1=#(11) INITIAL FUNNEL WASH BOTTLE#
295 I2=#(12) FINAL FUNNEL WASH BOTTLE#
300 I3=#(13) WASH WATER USED#
305 I4=#(14) FILTER FLASK, SAMPLE AND WASH WATER#
310 I5=#(15) FILTER FLASK#
315 I6=#(16) FILTRATE#
320 I7=#(17) FILTRATE-WASH WATER (6) + (13)#
325 I8=#(18) CRYSTALLIZING DISH AND WET COAL#
330 I9=#(19) CRYSTALLIZING DISH#
335 J=#(20) WET COAL#
340 J1=#(21) CRYSTALLIZING DISH AND DRY COAL#
345 J2=#(22) CRYSTALLIZING DISH#
350 J3=#(23) DRY COAL#
355 J4=#(24) MOISTURE = WET COAL (20) - DRY COAL (23)#
360 J5=#(25) PER CENT MOISTURE#
365 J6=#(26) TOLUENE EXTRACT, COAL AND CRYSTAL. DISH#
370 J7=#(27) CRYSTALLIZING DISH#
375 J8=#(28) EXTRACTED COAL#
380 J9=#(29) ML OF TOLUENE#
385 K4=#(30) SULFUR AND TAR, AND 4 OZ. SAMPLE BOTTLE#
390 K5=#(31) 4 OZ. SAMPLE BOTTLE#
395 K6=#(32) SULFUR AND TAR#
400 K7=#(33) SULFUR AND TAR AS PER CENT#
405 K8=#(34) PER CENT SLURRY#
410 K9=#(35) DILUTION FACTOR#
415 GOTO 60
700 WRITE ON 5 IN FORM F2:41,A
705 WRITE ON 5 IN FORM F2:42,B
710 WRITE ON 5 IN FORM F2:43,C
715 WRITE ON 5 IN FORM F2:44,D
720 WRITE ON 5:
725 WRITE ON 5:#        WEIGHTS, IN GRAMS#
730 WRITE ON 5:
```

Appendix A-7. (Continued)

```
735 WRITE ON 5 IN FORM F3:T1,E
740 WRITE ON 5 IN FORM F3:T2,F
745 WRITE ON 5 IN FORM F4:T3,F1
750 WRITE ON 5 IN FORM F3:T4,G
755 WRITE ON 5 IN FORM F3:T5,H
760 WRITE ON 5 IN FORM F4:T6,H1
765 WRITE ON 5 IN FORM F5:T7,H2
770 WRITE ON 5 IN FORM F3:T8,I
775 WRITE ON 5 IN FORM F3:T9,P
780 WRITE ON 5 IN FORM F4:I,P1
785 WRITE ON 5 IN FORM F3:I1,Q
790 WRITE ON 5 IN FORM F3:I2,R
795 WRITE ON 5 IN FORM F4:I3,R1
800 WRITE ON 5 IN FORM F3:I4,S
805 WRITE ON 5 IN FORM F3:I5,U
810 WRITE ON 5 IN FORM F4:I6,U1
815 WRITE ON 5 IN FORM F5:I7,U2
820 WRITE ON 5 IN FORM F3:I8,V
825 WRITE ON 5 IN FORM F3:I9,W
830 WRITE ON 5 IN FORM F4:J,W1
835 WRITE ON 5 IN FORM F3:J1,X
840 WRITE ON 5 IN FORM F3:J2,Y
845 WRITE ON 5 IN FORM F4:J3,Y1
850 WRITE ON 5 IN FORM F4:J4,Y2
855 WRITE ON 5 IN FORM F4:J5,Y3
860 WRITE ON 5 IN FORM F3:J6,Z
865 WRITE ON 5 IN FORM F3:J7,Z1
870 WRITE ON 5 IN FORM F4:J8,Z2
875 WRITE ON 5 IN FORM F3:J9,K
880 WRITE ON 5 IN FORM F3:K4,K1
885 WRITE ON 5 IN FORM F3:K5,K2
890 WRITE ON 5 IN FORM F4:K6,K3
895 WRITE ON 5 IN FORM F5:K7,L1
900 WRITE ON 5 IN FORM F5:K8,L2
905 WRITE ON 5 IN FORM F5:K9,L3
910 WRITE ON 5:
915 WRITE ON 5:
917 GOTO 1050
920 PRINT "DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)"
925 INPUT H5
930 IF H5="YES" THEN 35
998 CLOSE ALL

999 END
1000 PRINT "WHEVER OUTPUT FILE"
1005 INPUT H7
1010 OPEN H7,OUTPUT,6
1015 F6="I5 2B I6$ 2B 35 2B 45 2B 45.2S 2B 45.2S 2B 45.2S /"
1020 GOTO 35
1050 WRITE ON 6 IN FORM F6:A,B,C,D,L1,L2,L3
1055 GOTO 920
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D,H7
20 PRINT "OUTPUT FILE NAME"
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 1000
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEET DATA FOR ITEMS"
50 PRINT "1,2,4,5,7,8,10,11,15,16,18,19,23,24,26,27,30"
55 INPUT E,F,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z,L
100 F1=E-F
105 N1=M-N
110 P1=O-P
115 R1=Q-R
120 R2=R1-N1
125 T1=S-T
130 V1=U-V
135 V2=T1-V1
140 V3=V2/T1*100
145 X1=W-X
150 Z1=Y-Z
155 K1=P1/T1*V1/F1*100
160 K2=Z1*(L/100)/X1*100
165 K3=(V1-X1)/V1*100
170 K4=(R1/(F1-P1+N1))*(R1/(R1-N1))
200 F2="18$ 2B 20$ /"
205 F3="45$ 2B 4$.4$ /"
210 F4="45$ 9B 4$.4$ /"
215 F5="45$ 16B 4$.4$ /"
240 WRITE ON 5:"TEST PROCEDURE MY-01T-08"
245 WRITE ON 5:
250 WRITE ON 5 IN FORM F2:"EXPERIMENT NO.:",A
255 WRITE ON 5 IN FORM F2:"SAMPLING LOCATION:",B
260 WRITE ON 5 IN FORM F2:"SAMPLING DATE:",C
265 WRITE ON 5 IN FORM F2:"SAMPLING TIME:",D
270 WRITE ON 5:
275 WRITE ON 5:"                    WEIGHTS IN GRAMS"
280 WRITE ON 5:
285 WRITE ON 5 IN FORM F3:" (1) SAMPLE TANK AND SLURRY SAMPLE",E
290 WRITE ON 5 IN FORM F3:" (2) DRY SAMPLE TANK",F
295 WRITE ON 5 IN FORM F4:" (3) SAMPLE",F1
```

Appendix A-7. (Continued)

```
300 WRITE ON 5 IN FORM F3:# (4) WASH BOTTLE, INTIAL#,M
305 WRITE ON 5 IN FORM F3:# (5) WASH BOTTLE, FINAL#,N
310 WRITE ON 5 IN FORM F4:# (6) WASH WATER#,M1
315 WRITE ON 5 IN FORM F3:# (7) BUCHNER FUNNEL AND COAL CAKE#,O
320 WRITE ON 5 IN FORM F3:# (8) BUCHNER FUNNEL#,P
325 WRITE ON 5 IN FORM F4:# (9) COAL CAKE#,P1
330 WRITE ON 5 IN FORM F3:#(10) FILTER FLASK, SAMPLE AND WASH WATER#,Q
335 WRITE ON 5 IN FORM F3:#(11) FILTER FLASK#,R
340 WRITE ON 5 IN FORM F4:#(13) FILTRATE#,R1
345 WRITE ON 5 IN FORM F5:#(14) FILTRATE (13) - WASH WATER (6)#,R2
350 WRITE ON 5 IN FORM F3:#(15) CRYSTALLIZING DISH AND WET COAL#,S
355 WRITE ON 5 IN FORM F3:#(16) CRYSTALLIZING DISH#,T
360 WRITE ON 5 IN FORM F4:#(17) WET COAL#,T1
365 WRITE ON 5 IN FORM F3:#(18) CRYSTALLIZING DISH AND DRY COAL#,U
370 WRITE ON 5 IN FORM F3:#(19) CRYSTALLIZING DISH#,V
375 WRITE ON 5 IN FORM F4:#(20) DRY COAL#,V1
380 WRITE ON 5 IN FORM F4:#(21) MOISTURE = WET COAL (17) - DRY COAL (20)#,V2
385 WRITE ON 5 IN FORM F4:#(22) PER CENT MOISTURE#,V3
390 WRITE ON 5 IN FORM F3:#(23) TOLUENE EXTRACT. COAL AND CRYSTAL. DISH#,W
395 WRITE ON 5 IN FORM F3:#(24) CRYSTALLIZING DISH#,X
400 WRITE ON 5 IN FORM F4:#(25) EXTRACTED COAL#,X1
405 WRITE ON 5 IN FORM F3:#(26) SULFUR AND TAR AND 4 OZ. BOTTLE#,Y
410 WRITE ON 5 IN FORM F3:#(27) 4 OZ. BOTTLE#,Z
415 WRITE ON 5 IN FORM F4:#(28) SULFUR AND TAR#,Z1
420 WRITE ON 5 IN FORM F3:#(30) ML OF TOLUENE EXTRACT#,L
450 WRITE ON 5 IN FORM F5:#PER CENT SLURRY#,K1
455 WRITE ON 5 IN FORM F5:#PER CENT SULFUR AND TAR (TOLUENE RESIDUE)#,K2
460 WRITE ON 5 IN FORM F5:#PER CENT SULFUR AND TAR (COAL LOSS)#,K3
465 WRITE ON 5 IN FORM F5:#DILUTION FACTOR#,K4
470 GOTO 1050
480 WRITE ON 5:
485 WRITE ON 5:
500 PRINT #DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)#
505 INPUT H2
510 IF H2=#YES# THEN 35
998 CLOSE ALL
999 END
1000 PRINT #WEVER OUTPUT FILE#
1005 INPUT H7
1010 OPEN H7,OUTPUT,6
1015 F6=#F5 ZB 16$ ZB 3$ ZB 4$ ZB 4$.4$ ZB 4$.4$ ZB 4$.4$ /#
1020 GOTO 35

1050 WRITE ON 6 IN FORM F6:A,B,C,D,K1,K2,K4
1055 GOTO 480
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D,H3
20 PRINT "OUTPUT FILE NAME"
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 400
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEETS DATA FOR ITEMS 1,2,4,5"
50 INPUT E,F,M,N
100 F1=E-F
105 N1=M-N
110 N2=(F1-N1)/F1*100
115 F2="18$ 2B 20$ /"
120 F3="40$ 2B 4$.2$ /"
125 F4="40$ 9B 4$.2$ /"
130 F5="40$ 16B 3$.2$ /"
200 WRITE ON 5:"TEST PROCEDURE MX-01T-09"
205 WRITE ON 5:
210 WRITE ON 5 IN FORM F2:"EXPERIMENT NO.:",A
215 WRITE ON 5 IN FORM F2:"SAMPLING LOCATION:",B
220 WRITE ON 5 IN FORM F2:"SAMPLE DATE:",C
225 WRITE ON 5 IN FORM F2:"SAMPLE TIME:",D
230 WRITE ON 5:
 235 WRITE ON 5:"     WEIGHT IN GRAMS FOR WEIGH BELT AND S-1 FILTER SAMPLES"
240 WRITE ON 5:
245 WRITE ON 5 IN FORM F3:"(1) SAMPLE AND CRYSTALLIZING DISH",E
250 WRITE ON 5 IN FORM F3:"(2) CRYSTALLIZING DISH",F
255 WRITE ON 5 IN FORM F4:"(3) SAMPLE",F1
260 WRITE ON 5 IN FORM F3:"(4) DRY SAMPLE AND CRYSTALLIZING DISH",M
265 WRITE ON 5 IN FORM F3:"(5) CRYSTALLIZING DISH",N
270 WRITE ON 5 IN FORM F4:"(6) DRY SAMPLE",N1
275 WRITE ON 5 IN FORM F5:"(7) PER CENT MOISTURE",N2
280 WRITE ON 5:
285 WRITE ON 5:
287 GOTO 450
290 PRINT "DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)"
295 INPUT H2
300 IF H2="YES" THEN 35
398 CLOSE ALL
399 END
400 PRINT "NEVER OUTPUT FILE"

405 INPUT H3
410 OPEN H3,OUTPUT,6
415 F6="7$ 2B 16$ 2B 3$ 2B 4$ 2B 3$.2$ /"
420 GOTO 35
450 WRITE ON 6 IN FORM F6:A,B,C,D,N2
455 GOTO 290
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 DIM S(10),U(10),V(10),W(10),R(10),X(10),Y(10),Z(10),P(10)
20 STRING H1,H2,A,B,C,D,H4
25 PRINT "OUTPUT FILE NAME"
30 INPUT H1
32 GOTO 1100
35 OPEN H1,OUTPUT,5
40 PRINT "INPUT EXPERIMENT,, SAMPLE LOCATION, SAMPLING DATE, AND TIME"
45 INPUT A,B,C,D
50 PRINT "INPUT WEIGHT OF COAL AND SAMPLE BOTTLE"
55 INPUT X1
60 PRINT "INPUT WEIGHT OF SAMPLE BOTTLE"
65 INPUT X2
70 X=X1-X2
75 I=1
80 PRINT "INPUT SCREEN WEIGHTS (3E33 AFTER LAST WEIGHT)"
85 INPUT V(I)
90 IF V(I)=3E33 THEN 110
95 I=I+1
100 N1=N1+1
105 GOTO 85
110 I=1
115 PRINT "INPUT WEIGHTS W/COAL (3E33 AFTER LAST WEIGHT)"
120 INPUT W(I)
125 IF W(I)=3E33 THEN 145
130 I=I+1
135 N2=N2+1
140 GOTO 120
145 IF N1=N2 THEN 200
150 PRINT N1;N2
198 CLOSE ALL
199 END
200 PRINT "INPUT COAL TYPE (1=MEDIUM, 2=FINE)"
201 INPUT C1
202 IF C1=2 THEN 950
203 GOTO 900
204 FOR I=1 TO N1-1
205 READ S(I)
210 NEXT I
215 FOR I=1 TO N1
220 READ U(I)
225 NEXT I
```

Appendix A-7. (Continued)

```
230 FOR I=1 TO N1
232 R(I)=W(I)-V(I)
235 W=W+R(I)
240 X(I)=W
245 NEXT I
250 FOR I=1 TO N1
255 Y(I)=R(I)/W*100
260 Z=Y(I)+Z
265 Z(I)=Z
270 NEXT I
275 L=(X-W)/X*100
300 F1=#18$ 2B 20$/#
305 F2=#35$ 2B 3$.2$ /#
310 F3=#6$ B 7$ B 6$ B 6$ B 6$ 2B 4$ 2B 8$ 3B 4$ /#
315 F4=#B 4$ 2B 7$ B 5$ 2B 6$ 2B 4$ 2B 6$ B 8$ B 8$ /#
320 F5=#B 3$ 4B 4$ 3B 3$.2$ B 3$.2$ B 3$.2$ B 3$.2$ 2B 3$.2$ 3B 3$.2$ /#
325 F6=#35$ BB 3$.2$ /#
330 F7=#35$ 14B $$$.$$$$ /#
335 F8=#7$ 3B 4$ 3B 8$ /#
336 F9=#7$ B 8$ B 9$ /#
337 H3=#B 4$ 4B 3$.2$ 3B 3$.2$ /#
340 GOTO 490
345 WRITE ON 5:#TEST PROCEDURE "X-01T-10#
347 WRITE ON 5:
350 WRITE ON 5 IN FORM F1:#EXPERIMENT NO.:#,A
355 WRITE ON 5 IN FORM F1:#SAMPLE LOCATION:#,B
360 WRITE ON 5 IN FORM F1:#SAMPLING DATE:#,C
365 WRITE ON 5 IN FORM F1:#SAMPLING TIME:#,D
370 WRITE ON 5:
375 WRITE ON 5 IN FORM F2:#WEIGHT OF COAL AND SAMPLE BOTTLE:#,X1
380 WRITE ON 5 IN FORM F2:#WEIGHT OF SAMPLE BOTTLE:#,X2
385 WRITE ON 5 IN FORM F6:#WEIGHT OF COAL SAMPLE:#,X
390 WRITE ON 5:
395 WRITE ON 5 IN FORM F3:#SCREEN#,#SIZE IN#,#WEIGHT#,#WEIGHT#,#WEIGHT#,#CUM.#,#PER CENT#,#CUM.#
400 WRITE ON 5 IN FORM F4:#SIZE#,#MICRONS#,#EMPTY#,#W/COAL#,#COAL#,#WEIGHT#,#RETAINED#,#PER CENT#
405 WRITE ON 5:
410 FOR I=1 TO N1-1
415 WRITE ON 5 IN FORM F5:S(I),U(I),V(I),W(I),R(I),X(I),Y(I),Z(I)
420 NEXT I
425 WRITE ON 5 IN FORM F5:#PAN#,U(N1),V(N1),W(N1),R(N1),X(N1),Y(N1),Z(N1)
430 WRITE ON 5:
435 WRITE ON 5 IN FORM F6:#TOTAL WEIGHT ON SCREENS AND PAN#,W
```

Appendix A-7. (Continued)

```
440 WRITE ON 5 IN FORM F7:"PER CENT WEIGHT LOSS",L
445 GOTO 600
490 N=N1-1
500 FOR I=1 TO N
510 U(I)=LOG10(U(I)) ↓ X
515 S1=S1+U(I)
520 S2=S2+U(I)↑2
525 S3=S3+Z(I)
530 S4=S4+Z(I)↑2
535 Q1=Q1+U(I)*Z(I)
540 NEXT I
545 Q2=Q1-S1*S3/N
550 S5=S2-S1↑2/N
555 S6=S4-S3↑2/N
560 R=Q2/SQR(S5*S6)
565 M=Q2/S5 ↓ SLOPE
570 A$=(S3-M*S1)/N
585 Y3=10↑((36.79-A$)/M)
590 Y4=10↑((50.-A$)/M)
591 FOR I=1 TO N
592 P(I)=A$+M*U(I)
593 U(I)=10↑(U(I))
595 NEXT I
596 GOTO 345
600 WRITE ON 5:
605 WRITE ON 5:"THE EQUATION FOR THE LINEAR REGRESSION IS:"
610 WRITE ON 5:     "CUM PERCENT ="":A$:M:"(LOG (SIZE IN MICRONS))"
615 WRITE ON 5:     "THE CORR. COEF. ="":R
617 GOTO 1000
620 WRITE ON 5:
625 WRITE ON 5:"WHEN THE CUM. PER CENT = 36.79"
626 WRITE ON 5:" THE SCREEN SIZE ="":Y3:" MICRONS"
627 WRITE ON 5:
630 WRITE ON 5:"WHEN THE CUM. PER CENT = 50"
635 WRITE ON 5:" THE SCREEN SIZE ="":Y4:" MICRONS"
640 WRITE ON 5:
645 WRITE ON 5:
646 GOTO 1150
647 PRINT "DO YOU HAVE ANOTHER EXPERIMENT (YES OR NO)"
650 INPUT H2
655 IF H2="NO" THEN 198
660 W=0
```

Appendix A-7. (Continued)

```
665 Z=0
670 S1=0
675 S2=0
680 S3=0
685 S4=0
690 Q1=0
692 N1=0
693 N2=0
695 GOTO 40
900 S(1)=14
905 S(2)=35
906 S(3)=48
907 S(4)=100
908 S(5)=150
909 S(6)=200
910 U(1)=1190
911 U(2)=420
912 U(3)=297
913 U(4)=148
914 U(5)=105
915 U(6)=74
916 U(7)=0
920 GOTO 230
950 S(1)=100
956 S(2)=150
957 S(3)=200
958 S(4)=325
960 U(1)=149
961 U(2)=105
962 U(3)=74
963 U(4)=44
964 U(5)=0
965 GOTO 230
1000 WRITE ON 5:
1010 WRITE ON 5 IN FORM F8:"SIZE IN","CUM.%","PER CENT"
1015 WRITE ON 5 IN FORM F9:"MICRONS","PER CENT","PREDICTED"
1020 WRITE ON 5:
1025 FOR I=1 TO N
1030 WRITE ON 5 IN FORM H3:U(I),Z(I),P(I)
1035 NEXT I
1040 GOTO 620
1100 PRINT "WEVER OUTPUT FILE"
```

```
1105 INPUT H4
1110 OPEN H4,OUTPUT,6
1115 H5="S 2B 16S 2B 3S 2B 4S 2B 4S.5S 2B 4S.5S /"
1120 H6="10B 3S 2B 4S 2B 3S.2S 2B 3S.2S /"
1125 GOTO 35
1150 WRITE ON 6 IN FORM H5:A,B,C,D,Y3,Y4
1152 P(N1)=Z(N1)
1155 FOR I=1 TO N1
1160 WRITE ON 6 IN FORM H6:S(I),U(I),Z(I),P(I)
1162 NEXT I
1165 GOTO 647
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D,43
20 PRINT #OUTPUT FILE NAME#
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 400
35 PRINT #INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME#
40 INPUT A,B,C,D
45 PRINT #INPUT FROM WORK SHEET DATA FOR ITEMS#
50 PRINT #1,2,4,5,7,8,10,11#
55 INPUT E,F,M,N,O,P,Q,R
60 PRINT #INPUT DILUTION FACTOR CALCULATED FOR THIS EXPERIMENT#
65 PRINT #BY TEST PROCEDURE MX-01T-07#
70 INPUT D1
100 F1=E-F
105 N1=M*N*5.584*D1/F1
110 P1=O-P
115 R1=Q*R*5.584*D1/P1
120 Y=(R1-N1)/R1
125 F2=#18$ 28 20$ /#
130 F3=#40$ 28 35.4$ /#
135 F4=#40$ 108 35.4$ /#
140 F5=#40$ 188 35.4$ /#
200 WRITE ON 5:#TEST PROCEDURE MX-01T-11#
205 WRITE ON 5:
210 WRITE ON 5 IN FORM F2:#EXPERIMENT NO.:#,A
215 WRITE ON 5 IN FORM F2:#SAMPLING LOCATION:#,B
220 WRITE ON 5 IN FORM F2:#SAMPLE DATE:#,C
225 WRITE ON 5 IN FORM F2:#SAMPLE TIME:#,D
230 WRITE ON 5:
232 WRITE ON 5 IN FORM F3:#DILUTION FACTOR FROM PROC. MX-01T-07#,D1
233 WRITE ON 5:
235 WRITE ON 5:#                    WEIGHTS IN GRAMS#
240 WRITE ON 5:#                  FERROUS DETERMINATION#
245 WRITE ON 5:
255 WRITE ON 5 IN FORM F3:# (1) SAMPLE AND BEAKER#,E
260 WRITE ON 5 IN FORM F3:# (2) BEAKER#,F
265 WRITE ON 5 IN FORM F4:# (3) SAMPLE#,F1
270 WRITE ON 5 IN FORM F3:# (4) ML 0.1N K2CR207#,M
275 WRITE ON 5 IN FORM F3:# (5) NORMALITY OF K2CR207#,N
280 WRITE ON 5 IN FORM F4:# (6) PER CENT FERROUS IRON#,N1
285 WRITE ON 5:
```

Appendix A-7. (Continued)

```
290 WRITE ON 5:#                    TOTAL IRON DETERMINATION#
295 WRITE ON 5:
300 WRITE ON 5 IN FORM F3:# (7) SAMPLE AND BEAKER#,Q
305 WRITE ON 5 IN FORM F3:# (8) BEAKER#,P
310 WRITE ON 5 IN FORM F4:# (9) SAMPLE#,P1
315 WRITE ON 5 IN FORM F3:#(10) ML 0.1N K2CR2O7#,Q
320 WRITE ON 5 IN FORM F3:#(11) NORMALITY OF K2CR2O7#,R
325 WRITE ON 5 IN FORM F4:#(12) PER CENT TOTAL IRON#,R1
330 WRITE ON 5 IN FORMF5:#(13) Y VALUE#,Y
335 WRITE ON 5:
340 WRITE ON 5:
342 GOTO 450
345 PRINT #DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)#
350 INPUT H2
355 IF H2=#YES# THEN 35
398 CLOSE ALL
399 END
400 PRINT #WEVER OUTPUT FILE#
405 INPUT H3
410 OPEN H3,OUTPUT,6
415 F6=#7$ 2B 16$ 2B 3$ 2B 4$ 2B 3$.4$ 2B 3$.4$ 2B 3$.4$ /#
420 GOTO 35
450 WRITE ON 6 IN FORM F6:A,B,C,D,N1,R1,Y
455 GOTO 345
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D
20 PRINT "OUTPUT FILE NAME"
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 500
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEETS DATA FOR ITEMS"
50 PRINT "1,2,4,5,7,8,11,12,14,15"
55 INPUT E,F,M,N,O,P,Q,R,S,T
100 F1=E-F
105 N1=M*N*5.58/F1
110 P1=O-P
115 P2=P1*13.735/F1
120 R1=Q-R
125 T1=(S/R1-R/F1)*T*6.412
130 F2="10$ 2B 20$ /"
135 F3="40$ 2B 3$.4$ /"
140 F4="40$ 10B 3$.4$ /"
145 F5="40$ 18B 3$.4$ /"
190 WRITE ON 5:"TEST PROCEDURE MX-01T-12"
195 WRITE ON 5:
200 WRITE ON 5 IN FORM F2:"EXPERIMENT NO.:",A
205 WRITE ON 5 IN FORM F2:"SAMPLING LOCATION:",B
210 WRITE ON 5 IN FORM F2:"SAMPLING DATE:",C
215 WRITE ON 5 IN FORM F2:"SAMPLING TIME:",D
220 WRITE ON 5:
225 WRITE ON 5:"                    WEIGHTS IN GRAMS SULFATE SULFUR"
230 WRITE ON 5:
235 WRITE ON 5 IN FORM F3:" (1) SAMPLE AND WEIGHING BOTTLE",E
240 WRITE ON 5 IN FORM F3:" (2) WEIGHING BOTTLE",F
245 WRITE ON 5 IN FORM F4:" (3) SAMPLE",F1
250 WRITE ON 5 IN FORM F3:" (4) ML 0.1N K2CR2O7",M
255 WRITE ON 5 IN FORM F3:" (5) NORMALITY OF 0.1N K2CR2O7",N
260 WRITE ON 5 IN FORM F5:" (6) PER CENT NON-PYRITIC IRON",N1
265 WRITE ON 5 IN FORM F3:" (7) BARIUM SULFATE AND CRUCIBLE",O
270 WRITE ON 5 IN FORM F3:" (8) CRUCIBLE",P
275 WRITE ON 5 IN FORM F4:" (9) BARIUM SULFATE",P1
280 WRITE ON 5 IN FORM F5:"(10) PER CENT SULFATE SULFUR AS SULFUR",P2
285 WRITE ON 5:
290 WRITE ON 5:"                    WEIGHTS IN GRAMS PYRITIC SULFUR"
```

Appendix A-7. (Continued)

```
295 WRITE ON 5:
300 WRITE ON 5 IN FORM F3:$(11) SAMPLE AND WEIGHING BOTTLE$,Q
305 WRITE ON 5 IN FORM F3:$(12) WEIGHING BOTTLE$,R
310 WRITE ON 5 IN FORM F4:$(13) SAMPLE$,R1
315 WRITE ON 5 IN FORM F3:$(14) ML K2CR207$,S
320 WRITE ON 5 IN FORM F3:$(15) NORMALITY OF 0.1N K2CR207$,T
325 WRITE ON 5 IN FORM F5:$(16) PER CENT PYRITIC - SULFUR AS SULFUR$,T1
340 GOTO 550
400 PRINT $DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)$
405 INPUT H2
410 IF H2=$YES$ THEN 35
498 CLOSE ALL
499 END
500 PRINT $WEVER OUTPUT FILE$
505 INPUT H3
510 OPEN H3,OUTPUT,6
515 F6=$7$ 2B 16$ 2B 3$ 2B 4$ 2B 3$.4$ 2B 3$.4$ 2B 3$.4$ /$
530 GOTO 35
550 WRITE ON 6 IN FORM F6:A,B,C,D,N1,P2,T1
555 GOTO 400
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D,43
20 PRINT "OUTPUT FILE NAME"
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 400
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEETS DATA FOR ITEMS"
50 PRINT "1,2,4,5"
55 INPUT E,F,M,N
70 PRINT "INPUT DILUTION FACTOR CALCULATED FOR THIS EXPERIMENT"
75 PRINT "BY TEST PROCEDURE MX-01T-07"
80 INPUT D1
100 F1=E-F
105 N1=M-N
110 N2=N1*41.16/F1*D1
115 F2="$###.##"
120 F3="$##,###.##"
125 F4="$##,###.##"
130 F5="$##,###.##"
200 WRITE ON 5:"TEST PROCEDURE MX-01T-13"
205 WRITE ON 5:
210 WRITE ON 5 IN FORM F2:"EXPERIMENT NO.:",A
215 WRITE ON 5 IN FORM F2:"SAMPLING LOCATION:",B
220 WRITE ON 5 IN FORM F2:"SAMPLE DATE:",C
225 WRITE ON 5 IN FORM F2:"SAMPLE TIME:",D
230 WRITE ON 5:
235 WRITE ON 5 IN FORM F3:"DILUTION FACTOR FROM PROC. MX-01T-07",D1
240 WRITE ON 5:
245 WRITE ON 5 IN FORM F3:"BLANK CORRECTION (C)",C1
250 WRITE ON 5:
255 WRITE ON 5:"                    WEIGHT IN GRAMS"
260 WRITE ON 5:
265 WRITE ON 5 IN FORM F3:"(1) LEACH OR FILTRATE AND WEIGHING BOTTLE",E
270 WRITE ON 5 IN FORM F3:"(2) WEIGHING BOTTLE",F
275 WRITE ON 5 IN FORM F4:"(3) LEACH OR FILTRATE",F1
280 WRITE ON 5 IN FORM F3:"(4) BARIUM SULFATE AND CRUCIBLE",M
285 WRITE ON 5 IN FORM F3:"(5) CRUCIBLE",N
290 WRITE ON 5 IN FORM F4:"(6) BARIUM SULFATE",N1
295 WRITE ON 5 IN FORM F5:"(7) PER CENT SULFATE",N2
300 WRITE ON 5:
```

Appendix A-7. (Continued)

```
305 WRITE ON 5:
307 GOTO 450
310 PRINT "DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)"
315 INPUT H2
320 IF H2="YES" THEN 35
398 CLOSE ALL
399 END
400 PRINT "WEVER OUTPUT FILE"
405 INPUT H3
410 OPEN H3,OUTPUT,6
415 F6="7$ 2B 16$ 2B 3$ 2B 4$ 2B 3$,4$ /"
420 GOTO 35
450 WRITE ON 6 IN FORM F6:A,B,C,D,N2
455 GOTO 310
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 STRING H1,H2,A,B,C,D,H7
20 PRINT "OUTPUT FILE NAME"
25 INPUT H1
30 OPEN H1,OUTPUT,5
32 GOTO 1000
35 PRINT "INPUT EXPERIMENT NO., SAMPLING LOCATION, SAMPLING DATE, AND TIME"
40 INPUT A,B,C,D
45 PRINT "INPUT FROM WORK SHEET DATA FOR ITEMS"
50 PRINT "1,2,4,5,7,8,10,11,16,17,19,20,21"
55 INPUT E,F,M,N,O,P,Q,R,S,T,U,V,W
100 F1=E-F
105 M1=M-N
110 P1=O-P
115 R1=Q-R
120 R2=P1-R1
125 R3=R2/P1*100
130 T1=S-T
135 W1=V-W
140 X1=N1/P1*R1/F1*100
145 X2=W1/T1*U
200 F2="18$ 2B 20$ /"
205 F3="45$ 2B 45.4$ /"
210 F4="45$ 9B 45.4$ /"
215 F5="45$ 16B 45.4$ /"
240 WRITE ON 5:"TEST PROCEDURE MX-01T-16"
245 WRITE ON 5:
250 WRITE ON 5 IN FORM F2:"EXPERIMENT NO.:",A
255 WRITE ON 5 IN FORM F2:"SAMPLING LOCATION:",B
260 WRITE ON 5 IN FORM F2:"SAMPLING DATE:",C
265 WRITE ON 5 IN FORM F2:"SAMPLING TIME:",D
270 WRITE ON 5:
275 WRITE ON 5:"      WEIGH BELT (S-1) SAMPLE WORK UP SHEET"
280 WRITE ON 5:
285 WRITE ON 5 IN FORM F3:" (1) SAMPLE BOTTLE AND SAMPLE WEIGHT",E
290 WRITE ON 5 IN FORM F3:" (2) SAMPLE BOTTLE WEIGHT",F
295 WRITE ON 5 IN FORM F4:" (3) SAMPLE WEIGHT",F1
300 WRITE ON 5 IN FORM F3:" (4) BUCHNER FUNNEL AND COAL CAKE",M
305 WRITE ON 5 IN FORM F3:" (5) BUCHNER FUNNEL",N
310 WRITE ON 5 IN FORM F4:" (6) COAL CAKE",N1
315 WRITE ON 5 IN FORM F3:" (7) CRYSTALLIZING DISH AND WET COAL",O
320 WRITE ON 5 IN FORM F3:" (8) CRYSTALLIZING DISH",P
```

Appendix A-7. (Continued)

```
325 WRITE ON 5 IN FORM F4:# (9) WET COAL#,P1
330 WRITE ON 5 IN FORM F3:#(10) CRYSTALLIZING DISH AND DRY COAL#,Q
335 WRITE ON 5 IN FORM F3:#(11) CRYSTALLIZING DISH#,R
340 WRITE ON 5 IN FORM F4:#(12) DRY COAL#,R1
345 WRITE ON 5 IN FORM F4:#(14) MOISTURE = WET COAL (9) - DRY COAL (13)#,R2
350 WRITE ON 5 IN FORM F4:#(15) PER CENT MOISTURE#,R3
355 WRITE ON 5 IN FORM F3:#(16) TOLUENE EXTRACT. COAL AND CRYSTALL. DISH#,S
360 WRITE ON 5 IN FORM F3:#(17) CRYSTALLIZING DISH#,T
365 WRITE ON 5 IN FORM F4:#(18) EXTRACTED COAL#,T1
370 WRITE ON 5 IN FORM F3:#(19) ML OF TOLUENE EXTRACT#,U
375 WRITE ON 5 IN FORM F3:#(20) SULFUR AND TAR + 4-OZ. SAMPLE BOTTLE#,V
380 WRITE ON 5 IN FORM F3:#(21) 4-OZ. SAMPLE BOTTLE#,W
385 WRITE ON 5 IN FORM F4:#(22) SULFUR AND TAR#,W1
390 WRITE ON 5 IN FORM F5:#(23) PER CENT SOLIDS#,X1
395 WRITE ON 5 IN FORM F5:#(24) PER CENT SULFUR AND TAR#,X2
400 GOTO 1050
405 WRITE ON 5:
410 WRITE ON 5:
500 PRINT #DO YOU HAVE ANOTHER EXPERIMENT (INPUT YES OR NO)#
505 INPUT H2
510 IF H2=#YES# THEN 35
598 CLOSE ALL
599 END
1000 PRINT #WEVER OUTPUT FILE#
1005 INPUT H7
1010 OPEN H7,OUTPUT,6
1015 F6=#7$ 2B 16$ 2B 3$ 2B 4$ 2B 4$,4$ 2B 4$,4$ /#
1020 GOTO 35
1050 WRITE ON 6 IN FORM F6:A,B,C,D,X1,X2
1055 GOTO 405
```

Appendix A-7. (Continued)

```
10 VAR=ZERO
15 DIM S(10),U(10),V(10),W(10),R(10),X(10),Y(10),Z(10),P(10)
20 STRING H1,H2,A,B,C,D,H4
25 PRINT "OUTPUT FILE NAME"
30 INPUT H1
32 GOTO 1100
35 OPEN H1,OUTPUT,5
40 PRINT "INPUT EXPERIMENT,, SAMPLE LOCATION, SAMPLING DATE, AND TIME"
45 INPUT A,B,C,D
50 PRINT "INPUT WEIGHT OF COAL AND SAMPLE BOTTLE"
55 INPUT X1
60 PRINT "INPUT WEIGHT OF SAMPLE BOTTLE"
65 INPUT X2
70 X=X1-X2
75 I=1
80 PRINT "INPUT SCREEN WEIGHTS (3E33 AFTER LAST WEIGHT)"
85 INPUT V(I)
90 IF V(I)=3E33 THEN 110
95 I=I+1
100 N1=N1+I
105 GOTO 85
110 I=1
115 PRINT "INPUT WEIGHTS W/COAL (3E33 AFTER LAST WEIGHT)"
120 INPUT W(I)
125 IF W(I)=3E33 THEN 145
130 I=I+1
135 N2=N2+1
140 GOTO 120
145 IF N1=N2 THEN 200
150 PRINT N1;N2
198 CLOSE ALL
199 END
200 PRINT "INPUT COAL TYPE (1=MEDIUM, 2=FINE)"
201 INPUT C1
202 IF C1=2 THEN 950
203 GOTO 900
204 FOR I=1 TO N1-1
205 READ S(I)
210 NEXT I
215 FOR I=1 TO N1
220 READ U(I)
225 NEXT I
```

Appendix A-7. (Continued)

```
230 FOR I=1 TO N1
232 R(I)=W(I)-V(I)
235 W=W+R(I)
240 X(I)=W
245 NEXT I
250 FOR I=1 TO N1
255 Y(I)=R(I)/W*100
260 Z=Y(I)+Z
265 Z(I)=Z
270 NEXT I
275 L=(X-W)/X*100
300 F1=$16$ 2B 20$/$
305 F2=$35$ 2B 3$.2$ /$
310 F3=$6$ B 7$ B 6$ B 6$ B 4$ 2B 4$ 2B 8$ 3B 4$ /$
315 F4=$B 4$ 2B 7$ B 5$ 2B 6$ 2B 4$ 2B 6$ B 8$ B 8$ /$
320 F5=$B 3$ 4B 4$ 3B 3$.2$ B 3$.2$ B 3$.2$ B 3$.2$ 2B 3$.2$ 3B 3$.2$ /$
325 F6=$35$ 8B 3$.2$ /$
330 F7=$35$ 14B $$$.$$$$ /$
335 F8=$7$ 3B 4$ 3B 8$ /$
336 F9=$7$ B 8$ B 9$ /$
337 H3=$B 4$ 4B 3$.2$ 3B 3$.2$ /$
340 GOTO 490
345 WRITE ON 5:$TEST PROCEDURE MX-01T-10$
347 WRITE ON 5:
350 WRITE ON 5 IN FORM F1:$EXPERIMENT NO.:$,A
355 WRITE ON 5 IN FORM F1:$SAMPLE LOCATION:$,B
360 WRITE ON 5 IN FORM F1:$SAMPLING DATE:$,C
365 WRITE ON 5 IN FORM F1:$SAMPLING TIME:$,D
370 WRITE ON 5:
375 WRITE ON 5 IN FORM F2:$WEIGHT OF COAL AND SAMPLE BOTTLE:$,X1
380 WRITE ON 5 IN FORM F2:$WEIGHT OF SAMPLE BOTTLE:$,X2
385 WRITE ON 5 IN FORM F6:$WEIGHT OF COAL SAMPLE:$,X
390 WRITE ON 5:
395 WRITE ON 5 IN FORM F3:$SCREEN$,$SIZE IN$,$WEIGHT$,$WEIGHT$,$WEIGHT$,$CUM.$,$PER CENT$,$CUM.$
400 WRITE ON 5 IN FORM F4:$SIZE$,$MICRONS$,$EMPTY$,$W/COAL$,$COAL$,$WEIGHT$,$RETAINED$,$PER CENT$
405 WRITE ON 5:
410 FOR I=1 TO N1-1
415 WRITE ON 5 IN FORM F5:S(I),U(I),V(I),W(I),R(I),X(I),Y(I),Z(I)
420 NEXT I
425 WRITE ON 5 IN FORM F5:$PAN$,U(N1),V(N1),W(N1),R(N1),X(N1),Y(N1),Z(N1)
430 WRITE ON 5:
435 WRITE ON 5 IN FORM F6:$TOTAL WEIGHT ON SCREENS AND PAN$,W
```

Appendix A-7. (Continued)

```
440 WRITE ON 5 IN FORM F7:"PER CENT WEIGHT LOSS",L
445 GOTO 600
490 N=N1-1
500 FOR I=1 TO N
510 U(I)=LOG10(U(I)) ' X
515 S1=S1+U(I)
520 S2=S2+U(I)↑2
525 S3=S3+Z(I)
530 S4=S4+Z(I)↑2
535 Q1=Q1+U(I)*Z(I)
540 NEXT I
545 Q2=Q1-S1*S3/N
550 S5=S2-S1↑2/N
555 S6=S4-S3↑2/N
560 R=Q2/SQR(S5*S6)
565 M=Q2/S5 ' SLOPE
570 A$=(S3-M*S1)/N
585 Y3=10↑((36.79-A$)/M)
590 Y4=10↑((50.-A$)/M)
591 FOR I=I TO N
592 P(I)=A$+M*U(I)
593 U(I)=10↑(U(I))
595 NEXT I
596 GOTO 345
600 WRITE ON 5:
605 WRITE ON 5:"THE EQUATION FOR THE LINEAR REGRESSION IS:"
610 WRITE ON 5:    "CUM PERCENT =":A$:M:"(LOG (SIZE IN MICRONS))"
615 WRITE ON 5:    "THE CORR. COEF. =":R
617 GOTO 1000
620 WRITE ON 5:
625 WRITE ON 5:"WHEN THE CUM. PER CENT = 36.79"
626 WRITE ON 5:" THE SCREEN SIZE =":Y3:" MICRONS"
627 WRITE ON 5:
630 WRITE ON 5:"WHEN THE CUM. PER CENT = 50"
635 WRITE ON 5:" THE SCREEN SIZE =":Y4:" MICRONS"
640 WRITE ON 5:
645 WRITE ON 5:
646 GOTO 1150
647 PRINT "DO YOU HAVE ANOTHER EXPERIMENT (YES OR NO)"
650 INPUT H2
655 IF H2="NO" THEN 198
660 W=0
```

Appendix A-7. (Continued)

```
665 Z=0
670 S1=0
675 S2=0
680 S3=0
685 S4=0
690 Q1=0
692 N1=0
693 N2=0
695 GOTO 40
900 S(1)=35
905 S(2)=48
906 S(3)=100
907 S(4)=150
908 S(5)=200
909 S(6)=200
910 U(1)=420
911 U(2)=297
912 U(3)=149
913 U(4)=105
914 U(5)=74
915 U(6)=0
916 U(7)=0
920 GOTO 230
950 S(1)=100
956 S(2)=150
957 S(3)=200
958 S(4)=325
960 U(1)=149
961 U(2)=105
962 U(3)=74
963 U(4)=44
964 U(5)=0
965 GOTO 230
1000 WRITE ON 5:
1010 WRITE ON 5 IN FORM F9:#STYE IN#,#CUM.#,#PER CENT#
1015 WRITE ON 5 IN FORM F9:#MICRONS#,#PER CENT#,#PREDICTED#
1020 WRITE ON 5:
1025 FOR I=1 TO N
1030 WRITE ON 5 IN FORM H3:U(I),Z(I),P(I)
1035 NEXT I
1040 GOTO 620
1100 PRINT #WEVER OUTPUT FILE#
1105 INPUT H4
1110 OPEN H4,OUTPUT,6
1115 H5=#7$ 2# 16$ 2# 3$ 2# 4$ 2# 4$.5$ 2# 4$.5$ /#
1120 H6=#10# 3$ 2# 4$ 2# 3$.2$ 2# 3$.2$ /#
1125 GOTO 35
1150 WRITE ON 6 IN FORM H5:A,B,C,D,Y3,Y4
1152 P(N1)=Z(N1)
1155 FOR I=1 TO N1
1160 WRITE ON 6 IN FORM H6:S(I),U(I),Z(I),P(I)
1162 NEXT I
1165 GOTO 647
```

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-07

EXPERIMENT NO.: 0107
SAMPLING LOCATION: P4
SAMPLING DATE: 321
SAMPLING TIME: 2344

WEIGHTS, IN GRAMS

(1) SAMPLE JAR, SAMPLE AND WASH WATER	1463.00		
(2) SAMPLE JAR	198.00		
(3) SAMPLE AND WASH WATER		1265.00	
(4) INTITAL WASH WATER BOTTLE	1175.00		
(5) FINAL WASH WATER BOTTLE	661.00		
(6) WASH WATER USED		514.00	
(7) SAMPLE (3) - (6)			751.00
(8) BUCHNER FUNNEL AND COAL CAKE	3769.00		
(9) BUCHNER FUNNEL	3555.00		
(10) COAL CAKE (WET)		214.00	
(11) INITIAL FUNNEL WASH BOTTLE	589.00		
(12) FINAL FUNNEL WASH BOTLE	109.00		
(13) WASH WATER USED		480.00	
(14) FILTER FLASK, SAMPLE AND WASH WATER	3522.00		
(15) FILTER FLASK	2011.00		
(16) FILTRATE		1511.00	
(17) FILTRATE-WASH WATER (6) + (13)			517.00
(18) CRYSTALLIZING DISH AND WET COAL	338.29		
(19) CRYSTALLIZING DISH	139.16		
(20) WET COAL		199.13	
(21) CRYSTALLIZING DISH AND DRY COAL	311.35		
(22) CRYSTALLIZING DISH	139.16		
(23) DRY COAL		172.19	
(24) MOISTURE = WET COAL (20) - DRY COAL (23)		26.94	
(25) PER CENT MOISTURE		13.53	
(26) TOLUENE EXTRACT, COAL AND CRYSTAL. DISH	310.92		
(27) CRYSTALLIZING DISH	139.16		
(28) EXTRACTED COAL		171.76	
(29) ML OF TOLUENE	525.00		
(30) SULFUR AND TAR, AND 4 OZ. SAMPLE BOTTLE	131.25		
(31) 4 OZ. SAMPLE BOTTLE	131.23		
(32) SULFUR AND TAR		.02	
(33) SULFUR AND TAR AS PER CENT			.06
(34) PER CENT SLURRY			24.64
(35) DILUTION FACTOR			2.88

Appendix A-7. (Continued)

Sample Output

[redacted] PROCEDURE MX-017-08

EXPERIMENT NO.: 0303
SAMPLING LOCATION: M5----REP1
[redacted] DATE: 010
[redacted] TIME: 2359

WEIGHTS IN GRAMS

(2)	SAMPLE TANK AND SLURRY SAMPLE	9237.0000	
(3)	DRY SAMPLE TANK	7519.0000	
(3)	SAMPLE		1718.0000
(4)	WASH BOTTLE, INTIAL	569.0000	
(5)	WASH BOTTLE, FINAL	106.0000	
(6)	WASH WATER		463.0000
(7)	BUCHNER FUNNEL AND COAL CAKE	4041.0000	
(8)	BUCHNER FUNNEL	3621.0000	
(9)	COAL CAKE		420.0000
(10)	FILTER FLASK, SAMPLE AND WASH WATER	3170.0000	
(11)	FILTER FLASK	1472.0000	
(13)	FILTRATE		1698.0000
(14)	FILTRATE (13) - WASH WATER (6)		1235.0000
[redacted]	CRYSTALLIZING DISH AND WET COAL	243.2200	
[redacted]	CRYSTALLIZING DISH	69.1700	
[redacted]	WET COAL		174.0500
(18)	CRYSTALLIZING DISH AND DRY COAL	228.9800	
(19)	CRYSTALLIZING DISH	69.1700	
(20)	DRY COAL		159.8100
[redacted]	MOISTURE = WET COAL (17) - DRY COAL (20)		14.2400
[redacted]	PER CENT MOISTURE		8.1816
[redacted]	TOLUENE EXTRACT, COAL AND CRYSTAL. DISH	226.2400	
(24)	CRYSTALLIZING DISH	69.1700	
(25)	EXTRACTED COAL		157.0700
(26)	SULFUR AND TAR AND 4 OZ. BOTTLE	181.9140	
(27)	4 OZ. BOTTLE	181.7257	
(28)	SULFUR AND TAR		.1883
(29)	ML OF TOLUENE EXTRACT	285.0000	
PER CENT SLURRY			22.4469
PER CENT SULFUR AND TAR (TOLUENE RESIDUE)			.3417
PER CENT SULFUR AND TAR (COAL LOSS)			[redacted]
[redacted]			[redacted]

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-09

EXPERIMENT NO.: 0303
SAMPLING LOCATION: A3
SAMPLE DATE: 010
SAMPLE TIME: 1930

WEIGHT IN GRAMS FOR WEIGH BELT AND S-1 FILTER SAMPLES

(1) SAMPLE AND CRYSTALLIZING DISH	364.32		
(2) CRYSTALLIZING DISH	157.18		
(3) SAMPLE		207.14	
(4) DRY SAMPLE AND CRYSTALLIZING DISH	358.00		
(5) CRYSTALLIZING DISH	157.18		
(6) DRY SAMPLE		200.82	
(7) PER CENT MOISTURE			3.05

TEST PROCEDURE MX-01T-09

EXPERIMENT NO.: 0303
SAMPLING LOCATION: A3
SAMPLE DATE: 010
SAMPLE TIME: 2246

WEIGHT IN GRAMS FOR WEIGH BELT AND S-1 FILTER SAMPLES

(1) SAMPLE AND CRYSTALLIZING DISH	368.93		
(2) CRYSTALLIZING DISH	157.40		
(3) SAMPLE		211.53	
(4) DRY SAMPLE AND CRYSTALLIZING DISH	362.30		
(5) CRYSTALLIZING DISH	157.40		
(6) DRY SAMPLE		204.90	
(7) PER CENT MOISTURE			3.13

TEST PROCEDURE MX-01T-09

EXPERIMENT NO.: 0303
SAMPLING LOCATION: A3
SAMPLE DATE: 011
SAMPLE TIME: 0254

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-10

EXPERIMENT NO.: 0303
SAMPLE LOCATION: A3
SAMPLING DATE: 810
SAMPLING TIME: 1030

WEIGHT OF COAL AND SAMPLE BOTTLE: 312.68
WEIGHT OF SAMPLE BOTTLE: 200.87
WEIGHT OF COAL SAMPLE: 111.81

SCREEN SIZE	SIZE IN MICRONS	WEIGHT EMPTY	WEIGHT W/COAL	WEIGHT COAL	CUM. WEIGHT	PER CENT RETAINED	CUM. PER CENT
35	420	391.52	401.20	9.68	9.68	8.71	8.71
48	297	409.68	418.30	8.62	18.30	7.76	16.47
100	149	357.68	383.39	25.71	44.01	23.14	39.61
150	105	363.15	377.78	14.63	58.64	13.17	52.77
200	74	342.70	357.78	15.08	73.72	13.57	66.34
PAN	0	343.20	380.60	37.40	111.12	33.66	100.00

TOTAL WEIGHT ON SCREENS AND PAN 111.12
PER CENT WEIGHT LOSS .6171

THE EQUATION FOR THE LINEAR REGRESSION IS:
CUM PERCENT = 208.0932*-77.159136(LOG (SIZE IN MICRONS))
THE CORR. COEF. =-.99722037E+00

SIZE IN MICRONS	CUM. PER CENT	PER CENT PREDICTED
420	8.71	6.50
297	16.47	18.20
149	39.61	41.31
105	52.77	53.84
74	66.34	64.76

WHEN THE CUM. PER CENT = 36.79
THE SCREEN SIZE = 170.52723 MICRONS

WHEN THE CUM. PER CENT = 50
THE SCREEN SIZE = 114.97122 MICRONS

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-11

EXPERIMENT NO.: 0303
SAMPLING LOCATION: MS
SAMPLE DATE: 010
SAMPLE TIME: 2335

DILUTION FACTOR FROM PROC. MX-01T-07 1.3257

WEIGHTS IN GRAMS
FERROUS DETERMINATION

(1) SAMPLE AND BEAKER	156.9300		
(2) BEAKER	114.9900		
(3) SAMPLE		41.9400	
(4) ML 0.1N K2Cr2O7	9.9000		
(5) NORMALITY OF K2Cr2O7	.1002		
(6) PER CENT FERROUS IRON		.1751	

TOTAL IRON DETERMINATION

(7) SAMPLE AND BEAKER	137.9800		
(8) BEAKER	95.8900		
(9) SAMPLE		42.0900	
(10) ML 0.1N K2Cr2O7	10.2000		
(11) NORMALITY OF K2Cr2O7	.1002		
(12) PER CENT TOTAL IRON		.1798	
(13) Y VALUE			.0259

TEST PROCEDURE MX-01T-11

EXPERIMENT NO.: 0303
SAMPLING LOCATION: MS
SAMPLE DATE: 010
SAMPLE TIME: 2337

DILUTION FACTOR FROM PROC. MX-01T-07 1.2896

WEIGHTS IN GRAMS
FERROUS DETERMINATION

APPENDIX A-7. (Continued)

Sample Output

TEST PROCEDURE MX-011-12

EXPERIMENT NO.: 0303
SAMPLING LOCATION: 43
SAMPLING DATE: 710
SAMPLING TIME: 1930

WEIGHTS IN GRAMS SULFATE SULFUR

(1) SAMPLE AND WEIGHING BOTTLE	58.3734		
(2) WEIGHING BOTTLE	54.0771		
(3) SAMPLE		4.2963	
(4) ML 0.1N K2CR207	2.1000		
(5) NORMALITY OF 0.1N K2CR2O7	.1002		
(6) PER CENT NON-PYRITIC IRON			.2733
(7) BARIUM SULFATE AND CRUCIBLE	9.3767		
(8) CRUCIBLE	9.3110		
(9) BARIUM SULFATE		.0657	
(10) PER CENT SULFATE SULFUR AS SULFUR			.2100

WEIGHTS IN GRAMS PYRITIC SULFUR

(11) SAMPLE AND WEIGHING BOTTLE	54.0771		
(12) WEIGHING BOTTLE	52.7047		
(13) SAMPLE		1.3724	
(14) ML K2CR207	4.9000		
(15) NORMALITY OF 0.1N K2CR2O7	.1002		
(16) PER CENT PYRITIC - SULFUR AS SULFUR			1.9799

TEST PROCEDURE MX-011-12

EXPERIMENT NO.: 0303
SAMPLING LOCATION: 45
SAMPLING DATE: 710
SAMPLING TIME: 2337

WEIGHTS IN GRAMS SULFATE SULFUR

(1) SAMPLE AND WEIGHING BOTTLE	54.0793		
(2) WEIGHING BOTTLE	49.0737		
(3) SAMPLE		5.0058	
(4) ML 0.1N K2CR2O7	.2000		
(5) NORMALITY OF 0.1N K2CR2O7	.1002		

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-13

EXPERIMENT NO.: 0303
SAMPLING LOCATION: 46
SAMPLE DATE: 010
SAMPLE TIME: 1835

DILUTION FACTOR FROM PROC. MX-01T-07	1.0000		
BLANK CORRECTION (C)	.0000		
WEIGHT IN GRAMS			
(1) LEACH OR FILTRATE AND WEIGHING BOTTLE	29.4652		
(2) WEIGHING BOTTLE	12.8271		
(3) LEACH OR FILTRATE		17.1381	
(4) BARIUM SULFATE AND CRUCIBLE	10.3638		
(5) CRUCIBLE	9.9335		
(6) BARIUM SULFATE		.4303	
(7) PER CENT SULFATE			1.0334

TEST PROCEDURE MX-01T-13

EXPERIMENT NO.: 0303
SAMPLING LOCATION: 48
SAMPLE DATE: 010
SAMPLE TIME: 2235

DILUTION FACTOR FROM PROC. MX-01T-07	1.0000		
BLANK CORRECTION (C)	.0000		
WEIGHT IN GRAMS			
(1) LEACH OR FILTRATE AND WEIGHING BOTTLE	29.0635		
(2) WEIGHING BOTTLE	12.8179		
(3) LEACH OR FILTRATE		16.2456	
(4) BARIUM SULFATE AND CRUCIBLE	10.5929		
(5) CRUCIBLE	10.0054		
(6) BARIUM SULFATE		.5875	
(7) PER CENT SULFATE			1.4885

Appendix A-7. (Continued)

Sample Output

TEST PROCEDURE MX-01T-1B

EXPERIMENT NO.: 0303
SAMPLING LOCATION: S1
SAMPLING DATE: 010
SAMPLING TIME: 1930

WEIGH BELT (S-1) SAMPLE WORK UP SHEET

(1)	SAMPLE BOTTLE AND SAMPLE WEIGHT	683.0000	
(2)	SAMPLE BOTTLE WEIGHT	256.0000	
(3)	SAMPLE WEIGHT		427.0000
(4)	BUCHNER FUNNEL AND COAL CAKE	2455.0000	
(5)	BUCHNER FUNNEL	2028.0000	
(6)	COAL CAKE		427.0000
(7)	CRYSTALLIZING DISH AND WET COAL	261.1400	
(8)	CRYSTALLIZING DISH	65.4300	
(9)	WET COAL		195.7100
(10)	CRYSTALLIZING DISH AND DRY COAL	237.6400	
(11)	CRYSTALLIZING DISH	65.4300	
(12)	DRY COAL		172.1100
(14)	MOISTURE = WET COAL (9) - DRY COAL (13)		23.6000
(15)	PER CENT MOISTURE		12.0587
(16)	TOLUENE EXTRACT. COAL AND CRYSTALL. DISH	235.4300	
(17)	CRYSTALLIZING DISH	65.4300	
(18)	EXTRACTED COAL		170.0100
(19)	ML OF TOLUENE EXTRACT	255.0000	
(20)	SULFUR AND TAR + 4-OZ. SAMPLE BOTTLE	181.7700	
(21)	4-OZ. SAMPLE BOTTLE	181.4944	
(22)	SULFUR AND TAR		.2756
(23)	PER CENT SOLIDS		86.0066
(24)	PER CENT SULFUR AND TAR		.4140

TEST PROCEDURE MX-01T-1B

EXPERIMENT NO.: 0303
SAMPLING LOCATION: S1
SAMPLING DATE: 011
SAMPLING TIME: 0037

WEIGH BELT (S-1) SAMPLE WORK UP SHEET

Appendix A-7. (Continued)

```
      PROGRAM RTUSRT(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE3,TAPE4)
C     READS SORTED WX FILES (RTU  J.DENSON), UPDATES CORRECTIONS,
C      WRITES NEW FILE WITH HEADING
C      (ASSUMES ORIGINAL ENTRY COMES AFTER NUMBERED REPLACEMENTS,
C        SINCE BLANKS ARE SORTED TO END)
      DIMENSION RUN(2),LOC(2),REP(2),DAY(2),TIME(2),DATA(4,2),FORM(7,7)
      DATA BLANK/1H /,IREP/3HREP/
      DATA FORM/
     169H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,27H   SN+TAR   SOLIDS
     2 D.F.),69H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,27H   SOLIDS   SN+
     3TAR     D.F.),61H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,9H MOISTURE
     4)          ,7*0.,
     569H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,27H   FERROUS    TFE
     6    Y),69H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,27H     HCLFE
     7 SS       SP),61H(4H1RUN,6X,8HLOCATION,10X,9HDAY  TIME,10H  REAG S
     8G4)        /
      INTEGER RUN,REP,DAY,TIME,BLANK
C
C
      REWIND 3
      REWIND 4
      DISPLAY *PROCEDURE NO.*
      ACCEPT IPROC
C     WRITE APPROPRIATE HEADING
      WRITE (4,FORM(1,IPROC-6))
      READ(3,1010) RUN(1),LOC(1),REP(1),DAY(1),TIME(1),(DATA(I,1),I=1,4)
   60 READ(3,1010) RUN(2),LOC(2),REP(2),DAY(2),TIME(2),(DATA(I,2),I=1,4)
      IF(EUF,3) 999,100
  100 IF(REP(2).EQ.IREP) GO TO 140
C     NEXT LINE IS NOT A REPLACEMENT
C     IF SAME AS PREVIOUS, BUT NOT REPLACEMENT, IGNORE
      IF(LOC(1).EQ.LOC(2).AND.DAY(1).EQ.DAY(2).AND.TIME(1).EQ.TIME(2))
     1   GO TO 60
  110 WRITE(4,1020) RUN(1),LOC(1),BLANK,BLANK,DAY(1),TIME(1),
     1                (DATA(I,1),I=1,4)
  115 RUN(1)=RUN(2)
      LOC(1)=LOC(2)
      DAY(1)=DAY(2)
      TIME(1)=TIME(2)
      DO 120 I=1,4
  120 DATA(I,1)=DATA(I,2)
      GO TO 60
```

Appendix A-8. Computer Program for Revision of Analytical Data Files.

```
C
C       FOUND REPLACEMENT LINE - CHECK LOC,DAY,TIME
  140 IF(LOC(1).EQ.LOC(2).AND.DAY(1).EQ.DAY(2).AND.TIME(1).EQ.TIME(2))
     1    GO TO 115
C       NO MATCH - KEEP BUT DONT REPLACE
       GO TO 110
  999 WRITE(4,1020) RUN(1),LOC(1),BLANK,BLANK,DAY(1),TIME(1),
     1                (DATA(I,1),I=1,4)
       STOP
C
 1010 FORMAT(A9,A2,4X,A3,9X,A3,A6,4A10)
 1020 FORMAT(1X,A9,A2,4X,A10,A2,A3,A6,4A10)
       END
```

Appendix A-8. (Continued)

```
      PROGRAM RTUPLT(INPUT,OUTPUT,TAPE1=INPUT,TAPE2=OUTPUT,TAPE4,TAPE5,
     1         TAPE50)
C     PLOTS SORTED WX FILES BY LOC. (1 PLOT/VARIABLE)
C     WX FILES ARE WRITTEN BY J.RILEY FOR J.DENSON - RTU DATA
C     WRITTEN 10/20/77 - D.HOPP
C
      DIMENSION TIME(52,20),DATA(52,20,3),NUM(20),TITLE(9),YTITLE(3,7),
     1          DATAT(3),Y0(3),YMAX(3),YINCR(3),HEAD(7),
     2          S(10),U(10),T(10),P(10),Z1(10)
      DATA TITLE/5H  DAY,9H      RUN,1H ,10H PROCEDURE,1H /,
     1    YTITLE/6HSN+TAR,6HSOLIDS,4HD.F.,6HSOLIDS,6HSN+TAR,4HD.F.,
     2           8HMOISTURE,2*0,25HPROCEDURE 10  CUM PERCENT,
     3           7HFERROUS,3HTEE,2H Y,5HMCLFE,2HSS,2HSP,
     4           8HREAG 504/
C
   20 DISPLAY *PROCEDURE NO.*
      ACCEPT IPROCT
      IPROC=IPROCT-6
      IF(IPROC.EQ.4.OR.IPROC.EQ.14) GO TO 400
      N=3
      IF(IPROC.EQ.3.OR.IPROC.EQ.7) N=1
      DISPLAY *ENTER TIME0,MAX*
      ACCEPT D0,H0,FM0,DMAX,HMAX,FMMAX
      T0=H0+FM0/60.
      TMAX=(DMAX-D0)*24.+HMAX+FMAX/60.
      TTOTAL=TMAX-T0
      DISPLAY *ENTER N SETS Y0,YMAX*
      DO 40 J=1,N
   40 ACCEPT Y0(J),YMAX(J)
      DO 50 I=1,15
   50 NUM(I)=0
C
C     READ TAPE4 - SKIP HEADING
      REWIND 4
      READ(4,1050) (HEAD(I),I=1,7)
      DO 200 I=1,1000
      IF(IPROC.EQ.12) GO TO 90
      GO TO (60,90,70,80,80,80,80),IPROC
   60 READ(4,1060) RUN,LOC,DAY,HR,FMIN,(DATAT(J),J=1,N)
      GO TO 100
   70 READ(4,1070) RUN,LOC,DAY,HR,FMIN,(DATAT(J),J=1,N)
      GO TO 100
```

Appendix A-9. Computer Program for Plotting Analytical Data.

```
   80 READ(4,1080) RUN,LOC,DAY,HR,FMIN,(DATAT(J),J=1,N)
      GO TO 100
   90 READ(4,1099) RUN,LOC,DAY,HR,FMIN,(DATAT(J),J=1,N)
 1050 FORMAT(7A10)
 1060 FORMAT(1X,A9,A2,16X,F3.0,2X,2F2.0,3F9.2)
 1070 FORMAT(1X,A9,A2,16X,F3.0,2X,2F2.0,F8.2)
 1080 FORMAT(1X,A9,A2,16X,F3.0,2X,2F2.0,3F10.4)
 1099 FORMAT(1X,A9,A2,16X,F3.0,2X,2F2.0,3F11.4)
 1090 FORMAT(7X,2F6.0,2F8.2)
 1091 FORMAT(A9,21X,A8,22X)
  100 IF(EOF,4) 300,110
  110 T=(DAY-D0)*24.+HR+FMIN/60.
      IF(T.LT.T0.OR.T.GT.TMAX) GO TO 200
  120 IF(I.GT.1) GO TO 150
C     1ST TIME - SET UP INITIAL LOC
      LOC1=LOC
      NLOC=1
      TITLE(3)=RUN
      GO TO 160
  150 IF(LOC.EQ.LOC1) GO TO 160
      NLOC=NLOC+1
      LOC1=LOC
  160 K=NUM(NLOC)=NUM(NLOC)+1
      TIME(K,NLOC)=T
      DO 170 J=1,N
  170 DATA(K,NLOC,J)=DATAT(J)
  200 CONTINUE
      DISPLAY *OVER 500 ENTRIES - PROGRAM WILL IGNORE REST AND PLOT 500*
C
C     PLOT
  300 ENCODE(10,3000,TITLE(1)) TITLE(1),DO
 3000 FORMAT(A7,F3.0)
      ENCODE(10,3010,TITLE(5)) IPROCT,TITLE(5)
 3010 FORMAT(I3,A7)
      CALL LOOK(50)
      TINCR=(TMAX-T0)/TTOTAL
      DO 390 J=1,N
      YINCR(J)=(YMAX(J)-Y0(J))/10.
      CALL AXIS(0.0,12HTIME (HOURS),12,TTOTAL,0.,T0,TINCR)
      CALL AXIS(0.0,YTITLE(J,IPROC),10,10.,90.,Y0(J),YINCR(J))
      CALL SYMBOL(0.,10.,.14,TITLE,0.,50)
C     PLOT ALL LOCATIONS FOR 1 VARIABLE
```

Appendix A-9. (Continued)

```
      DO 350 K=1,NLOC
      L=NUM(K)
      TIME(L+1,K)=T0
      TIME(L+2,K)=TINCR
      DATA(L+1,K,J)=Y0(J)
      DATA(L+2,K,J)=YINCR(J)
      CALL LINE(TIME(1,K),DATA(1,K,J),L,1,-1,K)
  350 CONTINUE
      CALL PLOT(17.25,0.,-3)
C     NEXT VARIABLE
  390 CONTINUE
      CALL PLOT(0.,0.,999)
      STOP
C
C      PROCEDURE 10 - PLOT LOG(OPENING) VS CUM PC AND PREDICTED CUM PC
C      READ TAPE 4 - HEADING AND LIST
  400 REWIND 4
      CALL LOOK(50)
      N=7
      IF(IPROC.EQ.14) N=6
      DISPLAY*ENTER 0 IF 1 SUMMARY, ENTER 1 IF AVERAGES WANTED*
      ACCEPT NAVG
      IF(NAVG.NE.0) GO TO 500
  410 READ(4,1091) HEAD(1),HEAD(2)
      IF(EOF,4) 499,420
  420 READ(4,1090) S(1),U(1),Z(1),P(1)
      IF(S(1).EQ.100.) N=5
      READ(4,1090) ((S(I),U(I),Z(I),P(I)),I=2,N)
      N1=N-1
      Z(N)=P(N)=0.
      Z(N+1)=P(N+1)=10.
C      PLOT ACTUAL=Z, PREDICTED=P
      CALL SCALG(U,16.,N1,1)
      CALL LGAXS(0.0,16HOPENING(MICRONS),-16,10.,0.,U(N),U(N+1))
      CALL AXIS(0.0,YTITLE(1,4),25,10.,90.,Z(N),Z(N+1))
      CALL SYMBOL(0.,10.,.14,HEAD,0.,20)
      CALL LGLIN(U,Z,N1,1,-1,1,-1)
      CALL LGLIN(U,P,N1,1,1,2,-1)
      CALL PLOT(17.25,0.,-3)
      GO TO 410
C
  499 CALL PLOT(0.,0.,999)
```

Appendix A-9. (Continued)

```
      STOP
C
C
C     PROCEDURE 10 - AVERAGE ALL FOLLOWING CUM PC, DO NEW PRED.,PLOT
  500 DO 505 I=1,10
  505 Z(I)=0.
      S1=S2=S3=S4=Q1=0.
      K=0
      REWIND 5
      DISPLAY *TAPE4 MUST HAVE A PLOT TITLE AS 1ST RECORD*
      READ(4,1100) (TITLE(I),I=1,7)
  510 READ(4,1091) TITLE(8),TITLE(9)
      IF(EOF,4) 540,515
  515 READ(4,1090) S(1),U(1),Z1(1),P(1)
      IF(S(1).EQ.100.) N=5
      READ(4,1090) ((S(I),U(I),Z1(I),P(I)),I=2,N)
      N1=N-1
      K=K+1
      DO 520 I=1,N1
  520 Z(I)=Z(I)+Z1(I)
      GO TO 510
  540 DO 560 I=1,N1
      Z(I)=Z(I)/K
      U(I)=ALOG10(U(I))
      S1=S1+U(I)
      S2=S2+U(I)**2
      S3=S3+Z(I)
      S4=S4+Z(I)**2
  560 Q1=Q1+U(I)*Z(I)
      Q2=Q1-S1*S3/N1
      S5=S2-S1**2/N1
      S6=S4-S3**2/N1
      R=Q2/SQRT(S5*S6)
      FM=Q2/S5
      A=(S3-FM*S1)/N1
      DO 570 I=1,N1
      P(I)=A+FM*U(I)
  570 U(I)=10.**(U(I))
      Z(N)=P(N)=0.
      Z(N+1)=P(N+1)=10.
C     WRITE SUMMARY
      WRITE(5,1101) TITLE
```

Appendix A-9. (Continued)

Appendix A-9. (Continued)

APPENDIX B. RTU PROCEDURES

APPENDIX B

RTU Procedures

OPERATING

Number	Rev.	Title
MX-01P-01	C	DORIC Digitrend Model 240 Microprocessor
MX-01P-02	B	Autoweigh Mark IV Weigh Belt Calibration
MX-01P-03		Leach Solution Scrubber Shutoff System
MX-01P-04		Heat Exchanger E-2 Steam Control
MX-01P-05	A	T-2 Slurry Feed Control System Operation
MX-01P-06		Reactor R-1 Low Level Shutoff Control System LT-59 Operation
MX-01P-07	A	R-1 Slurry Discharge Control System
MX-01P-08		Mixing Motor & Recirc. Pump Seal Flush Water Delta Pressure Control
MX-01P-09	A	Leach Soln. Feed Pump Control System
MX-01P-10	A	V-1 Vented Gas Control System
MX-01P-11		K-1 Vacuum Pump & Cooling Water
MX-01P-12		Vent Gas Scrubber Cooling Water Shutoff
MX-01P-13	A	Reactor R-2 Level Indicating System
MX-01P-14		Heat Exchanger E-3 Steam Control System
MX-01P-15		LC-107 Filtrate Receiver V-2 Hi-Lo Level Control
MX-01P-16		LC-108 Wash Water Receiver V-3 Hi-Lo Level Control System
MX-01P-17	B	FE-44 & FE-61 Ramapo Target Flowmeter
MX-01P-18		Electroscale Catch & Weigh System
MX-01P-26		Bin Dumping System Operation
MX-01P-27		T-2 Mixer/T-3 Scrubber System
MX-01P-28		R-1 Primary Reactor/V-1 Knockout Drum/T-4 Scrubber System Operation
MX-01P-29		S-1 Belt Filter System Operation
MX-01P-30		Tank Farm Handling Operation
MX-01P-31		R-2 Secondary Reactor System
MX-01P-32		Cooling Water Loop System Operation
MX-01P-33	A	Air Compressor/Air Dryer System Operation
MX-01P-34	A	Liquid Oxygen System Operation
MX-01P-35	B	Liquid Nitrogen System Operation
MX-01P-36	B	Steam Boiler/Propane Tank & Vaporizer/Softener
MX-01P-37		Waste Disposal Solids/Liquid Systems

OPERATING (Continued)

Number	Rev.	Title
MX-01P-38		Leach Solution Preparation
MX-01P-39		T-6 Coarse Coal Reactor System Operation
MX-01P-40	A	Pre-Test Facility Set-Up
MX-01P-41		Operating Sequence
MX-01P-42	A	RTU Securing Operation
MX-01P-43		General Coal Plant Operating Procedure
MX-01P-44	B	Check List For Startup, Operating & Shutdown
MX-01P-45	A	Instrumentation & Controls Pretest & Shutdown Check List
MX-01P-46		Suspect Line Removal For Destructive Analysis

SAMPLING

Number	Rev.	Title
MX-01T-01		Sampling Liquids & Slurries Test Procedure
MX-01T-02	A	Sampling A-3 Weigh Belt Feeder Dry Coal Test
MX-01T-03		Sampling R-1 Primary Reactor Bypass Slurry Test
MX-01T-04		Sampling S-1 Belt Filter Coal Test Proc.
MX-01T-05		Sampling T-6 Coarse Coal Leach Tank Dry Coal Test
MX-01T-06		Coal Leak Check/Well Water Flush Test Procedure

ANALYSIS

Number	Rev.	Title
MX-01T-07	B	Workup & Analysis of Slurry Samples From Pump Around Loops
MX-01T-08	B	Workup & Analysis of Slurry Samples From Sampling Valves
MX-01T-09	B	Processing of Coal for Chemical Analysis & Particle Size Distribution
MX-01T-10	A	Determination of Particle Size Distribution (PSD)
MX-01T-11	A	Determination of Total Iron Content. & Y Values For Leach & Filtrates
MX-01T-12	A	Determination of Sulfur Forms in Coal
MX-01T-13	B	Determination of Sulfate Conc. of Leach Soln. & Coal Slurry

ANALYSIS (Continued)

Number	Rev.	Title
MX-01F-01		Washing Coal for Preparation of Analyses Samples
MX-01F-02		Reaction of Coal & Leach Solution Under Atmospheric Conditions
MX-01F-03		Toluene Extraction of Coal and the Recycling of Water-Toluene
MX-01F-04		Gravichem Method of Coal Separation

CALIBRATION

Number	Rev.	Title
MX-01C-01	A	Fischer & Porter Converter Calibration & Operation
MX-01C-02	A	Taylor Servomex OA184 Oxygen Analyzer System Calibration & Operation

APPENDIX C. DESIGN CASE DETAILS

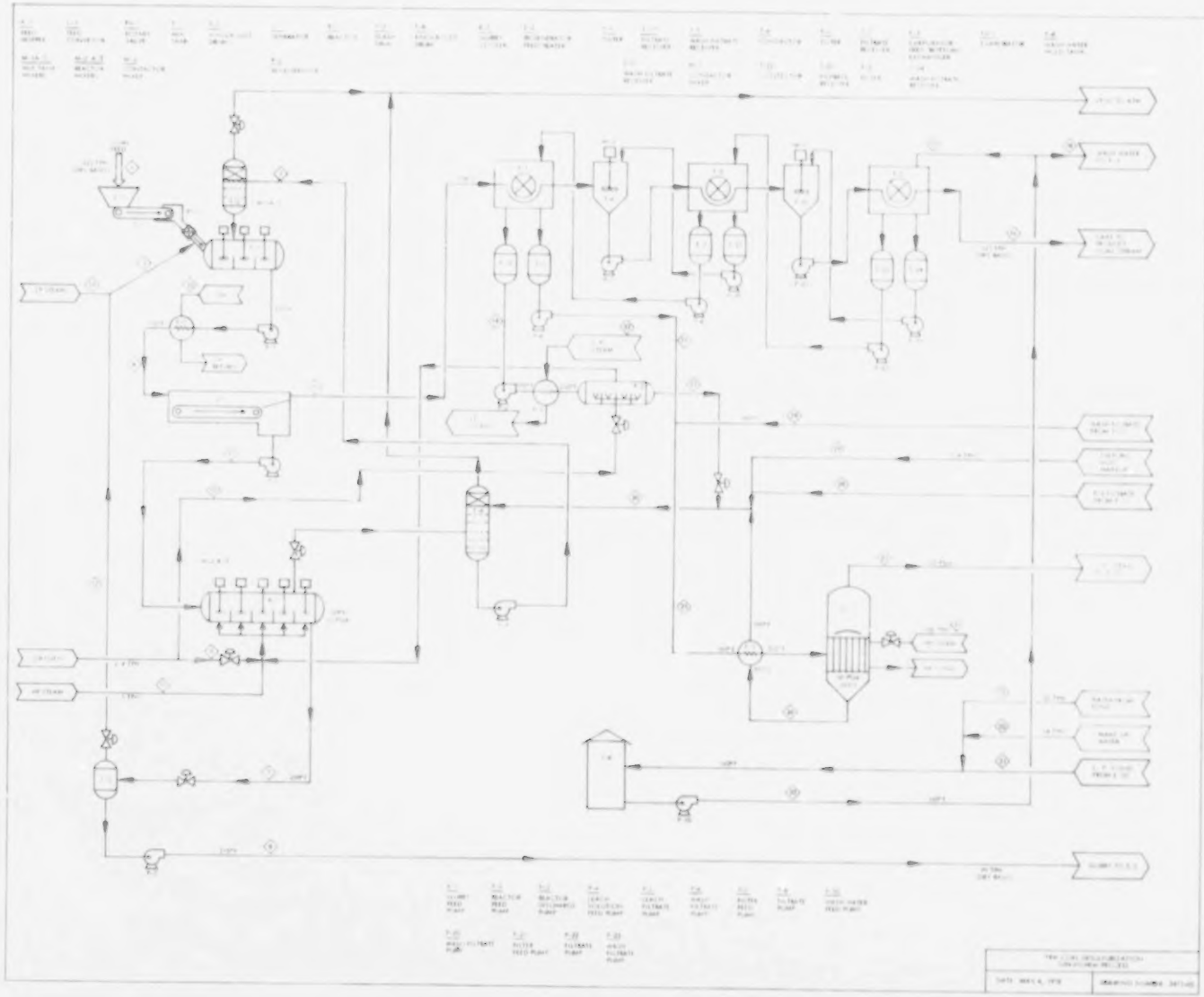

Figure C-1. TRW Coal Desulfurization Gravichem Process

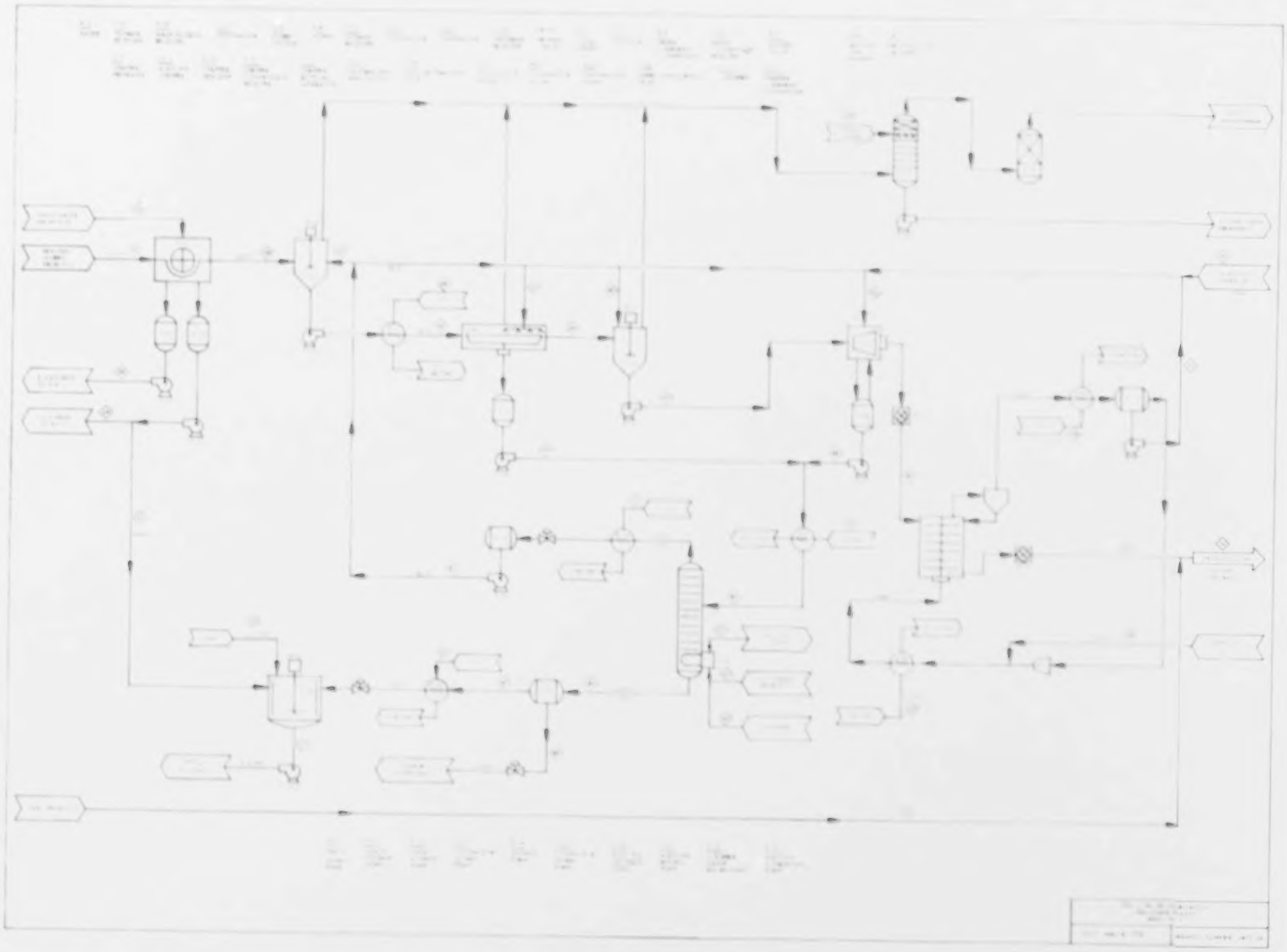

Figure C-2. TRW Coal Desulfurization Gravichem Process - Base Case 1

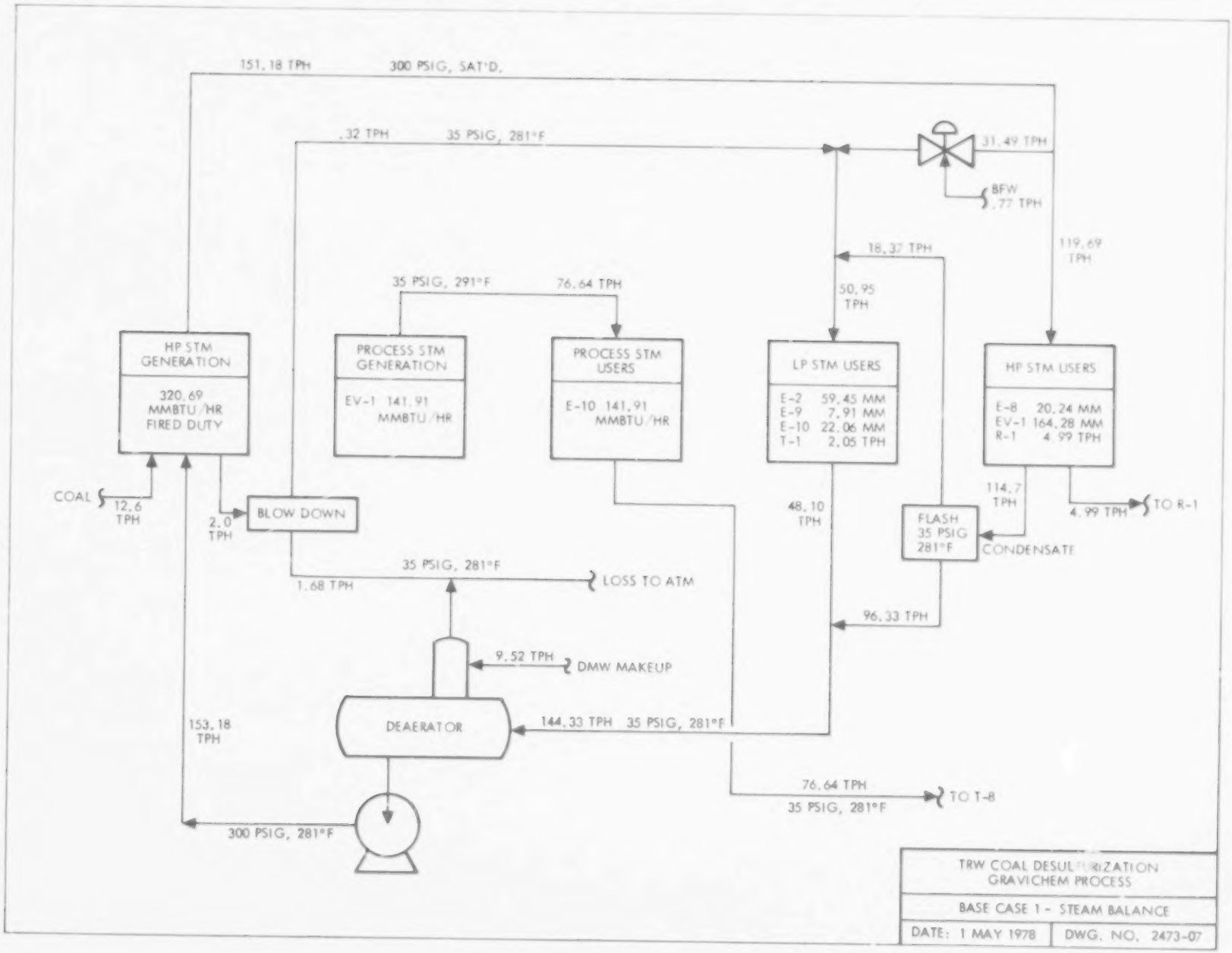

Figure C-3. TRW Coal Desulfurization Gravichem Process - Base Case 1 - Steam Balance

TABLE C-1. BASE CASE 1 - MARTINKA COAL MATERIAL BALANCE

Stream	1	2	3	4	5	6	7	8	9	10	11	12
Description	Coal Feed	Recycled Leach Solution	STM to R-1	Mixer Slurry	Float Coal Slurry	Sink Coal Slurry	Reactor Effluent Slurry	F-3 Feed Slurry	R-1 Oxygen Feed	R-2 Oxygen Feed	R-1 HP STM Feed	T-3 Flash STM
Water		455.60	4.99	464.99	325.53	139.41	144.53	137.73			4.99	6.80
$FeSO_4$		15.67		22.88	16.02	6.86	2.22	2.22				
$Fe_2(SO_4)_3$		160.28		151.28	105.20	45.05	55.52	55.52				
H_2SO_4		28.98		29.22	20.64	8.84	6.70	6.70				
Coal	290.79			290.79	122.66	98.13	98.13	98.13				
Pyrite	4.21			3.57	.61	2.89	.28	.28				
Sulfur				.74	.03	.13	.68	.68				
Oxygen									2.03	.23		
Nitrogen												
Acetone												
Lime												
Ammonia												
Total	294.99	660.53	4.99	962.50	590.69	301.31	308.06	301.26	2.03	.23	4.99	6.80
T (°F)	75	176	650	176	176	176	250	219	75	75	421	219
P (psia)	15	15	515	15	15	45	35	20	50	50	300	2.3

(Continued)

TABLE C-1. (Continued)

Stream	13	14	15	16	17	18	19	20	21	22	23
Description	LP Heating STM	F-1 Filtrate	F-1 Wash Filtrate	F-5 Coal Cake	F-5 Wash Water	F-3 Wash Water	Pond Water Return	Makeup Water	Recovered LP Condensate	Wash Water	Regen. Effluent
Water	2.85	263.88	123.30	61.65	123.30	69.37	62.23	53.8	76.64	192.67	264.14
$FeSO_4$		12.99	3.03	.002							8.62
$Fe_2(SO_4)_3$		85.28	19.91	.015							91.02
H_2SO_4		16.73	3.91	.003							15.32
Coal				122.66							
Pyrite				.61							
Sulfur				.03							
Oxygen											
Nitrogen											
Acetone											
Lime											
Gypsum											
Total, TPH	2.85	378.88	150.15	184.97	123.30	69.37	62.23	53.8	76.64	192.67	379.10
T, °F	290	160	160	160	160	160	75	75	281	160	250
P, PSIG	35	65	65	0	5	5	20	20	35	20	35

(Continued)

TABLE C-1. (Contined)

Stream	24	25	26	27	28	29	30	31	32	33	34
Description	F-3 Wash Filtrate	Evaporator Feed	Evaporator Bottoms	LP STM FM EV-1	F-3 Filtrate	Sulfuric Acid Makeup	Leach Solution Recycle	HP STM To EV-1	LP STM To E-2	CW To E-1	F-3 Coal Cake
Water	56.80	180.10	103.46	76.64	88.18	.03	455.81	102.11	31.98	868.5	49.55
$FeSO_4$	.59	3.62	3.62		1.42		13.67				.08
$Fe_2(SO_4)_3$	14.72	34.63	34.63		35.55		161.20				2.00
H_2SO_4	1.78	5.69	5.69		4.29	1.39	26.68				.24
Coal											98.13
Pyrite											.28
Sulfur											.68
Oxygen											
Nitrogen											
Acetone											
Lime											
Gypsum											
Total, TPH	73.89	224.04	147.40	76.64	129.44	1.42	657.36	102.11	31.98	868.5	150.96
T, °F	160	160	291	291	160	75	216	421	291	77	160
P, PSIG	35	35	35	35	35	35	0	300	35	50	0

(Continued)

TABLE C-1. (Continued)

Stream	35	36	37	38	39	40	41	42	43	44	45
Description	Acetone To T-11	Acetone/ Coal Slurry	Acetone To F-4	F-4 Coal Cake	F-4 Filtrate	Acetone To T-13	Acetone/ Coal Slurry	Acetone To CG-1	CG-1 Coal Cake	CG-1 Centrate	Stripper Feed
Water		49.55		1.34	48.21		1.34		NIL	1.34	49.55
$FeSO_4$		.08		NIL	.08		NIL		NIL		.08
$Fe_2(SO_4)_3$		2.00		.06	1.94		.06		.06		1.94
H_2SO_4		.24		.01	.23		.01		.01		.23
Coal		98.13		98.13			98.13		98.13		
Pyrite		.28		.28			.28		.28		
Sulfur		.68		.18	.50		.18		.08	.10	.60
Oxygen											
Nitrogen											
Acetone	96.78	96.78	40.00	38.30	98.48	110.0	148.30	40.0	12.0	176.30	274.78
Lime											
Gypsum											
Total, TPH	96.78	247.74	40.00	138.3	149.44	110.0	243.3	40.0	110.56	177.74	327.18
T, °F	85	85	85	85	85	85	85	85	85	85	106
P, PSIG	10	10	0	0	25	0	10	0	0	25	20

(Continued)

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APPENDIX C.	Design Case Details

	53	54
	Acetone Condensate	Nitrogen Makeup
		0.25
	11.9	0.25
	65	75
	25	20

TABLE C-1. (Continued)

Stream	55	56	57	58	59	60	61	62	63	64	65
Description	Acetone Makeup	Combined Coal Product	F-3 Wash Filt. To Neutr.	CW To E-6	HP STM To E-8	LP STM To E-10	CW To E-11	CW To E-12	LP STM To E-9	CW To E-5	Pond Water To GS-1
Water		61.65	12.57	350.5	12.58	11.87	2,608.4	154.3	4.26	197.0	30.0
$FeSO_4$		.004	.13								
$Fe_2(SO_4)_3$		.075	3.26								
H_2SO_4		.013	.39								
Coal		220.79									
Pyrite		.89									
Sulfur		.11									
Oxygen											
Nitrogen		.25									
Acetone	.10	.10									
Lime											
Gypsum											
Total, TPH	.10	283.53	16.35	350.5	12.58	11.87	2,608.4	154.3	4.26	197.0	30.0
T, °F	75	180	160	77	421	281	77	77	281	77	75
P, PSIG	25	0	35	50	300	35	50	50	35	50	10

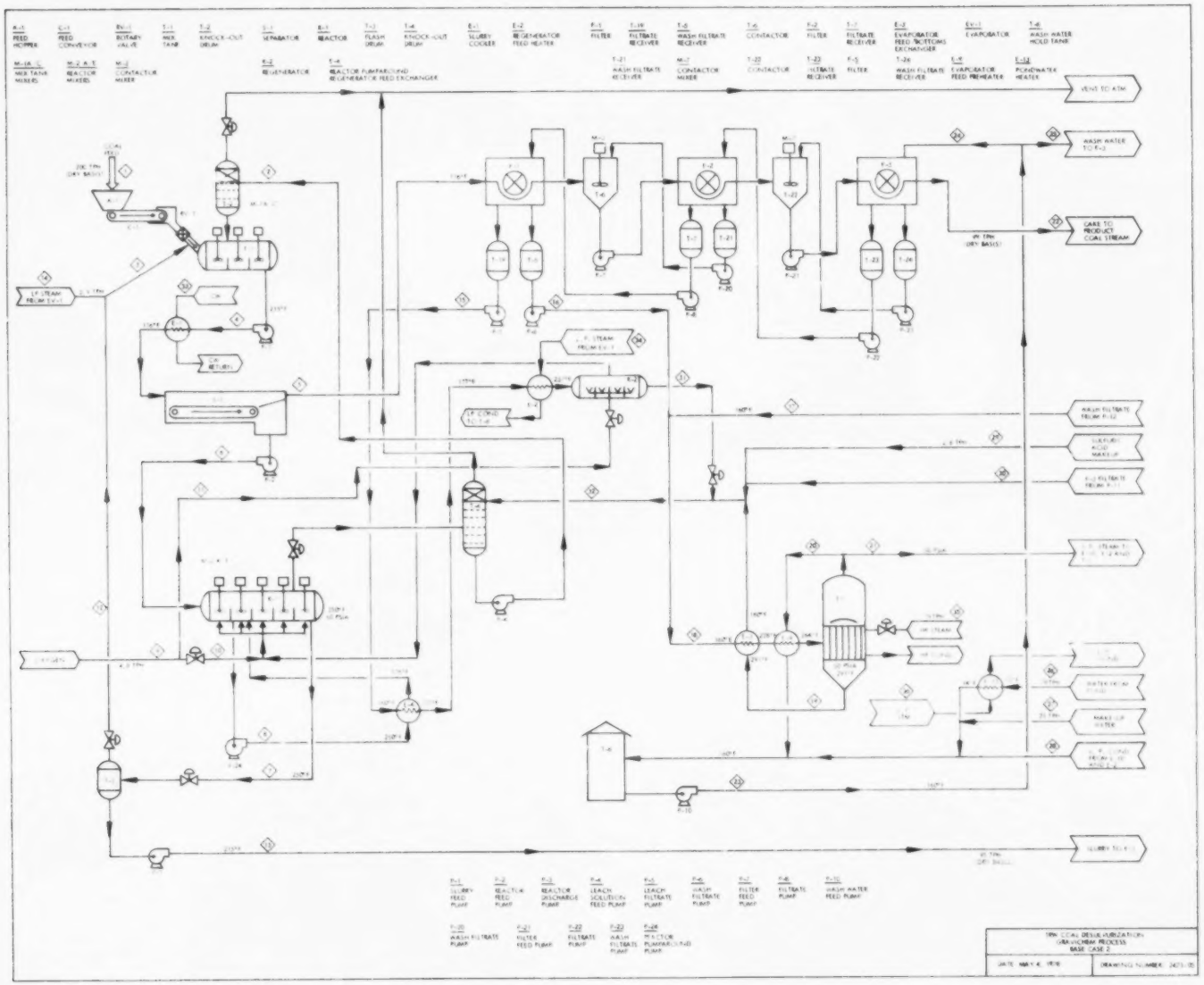

Figure C-4a. TRW Coal Desulfurization Gravichem Process - Base Case 2

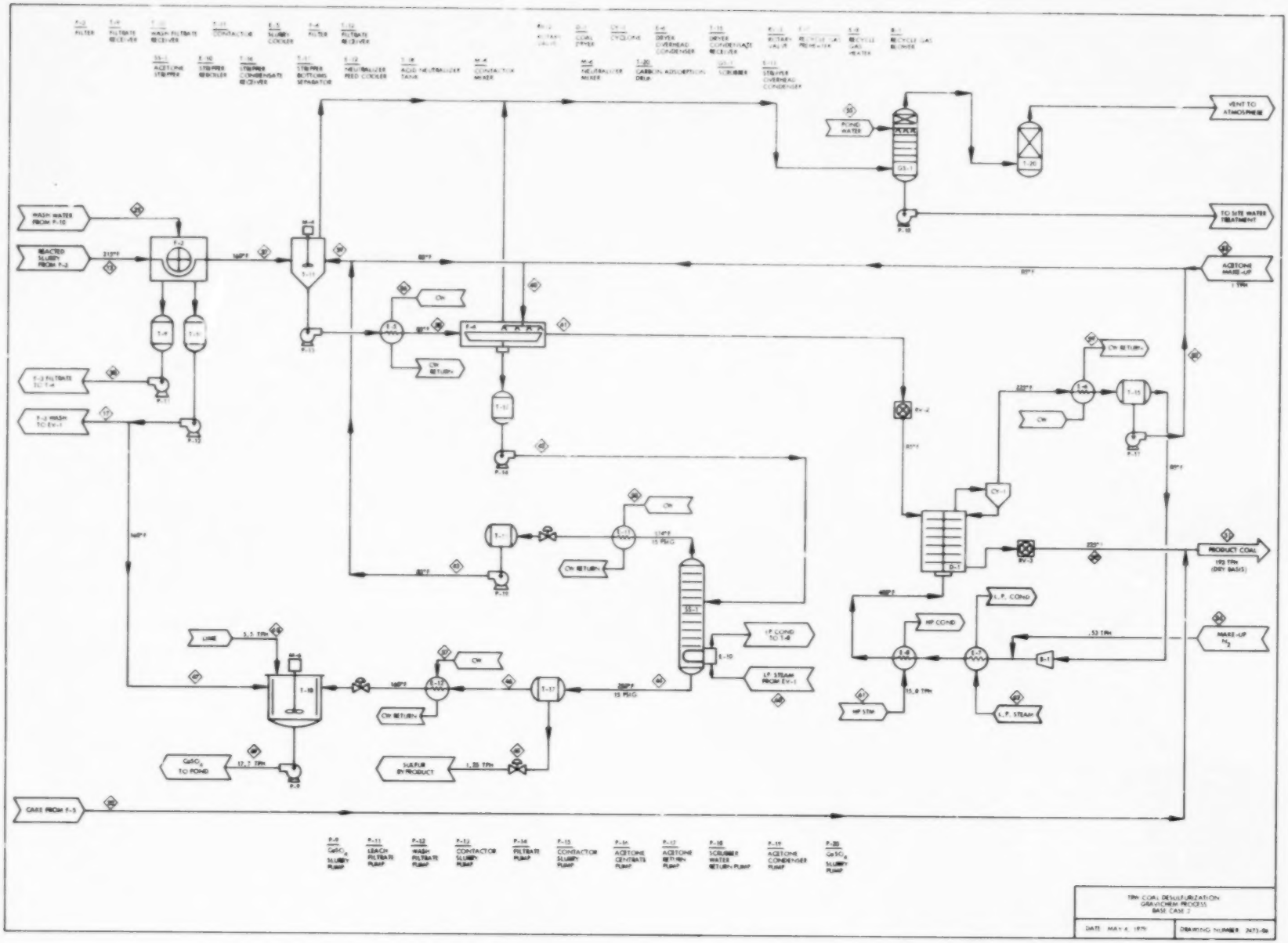

Figure C-4b. TRW Coal Desulfurization Gravichem Process - Base Case 2

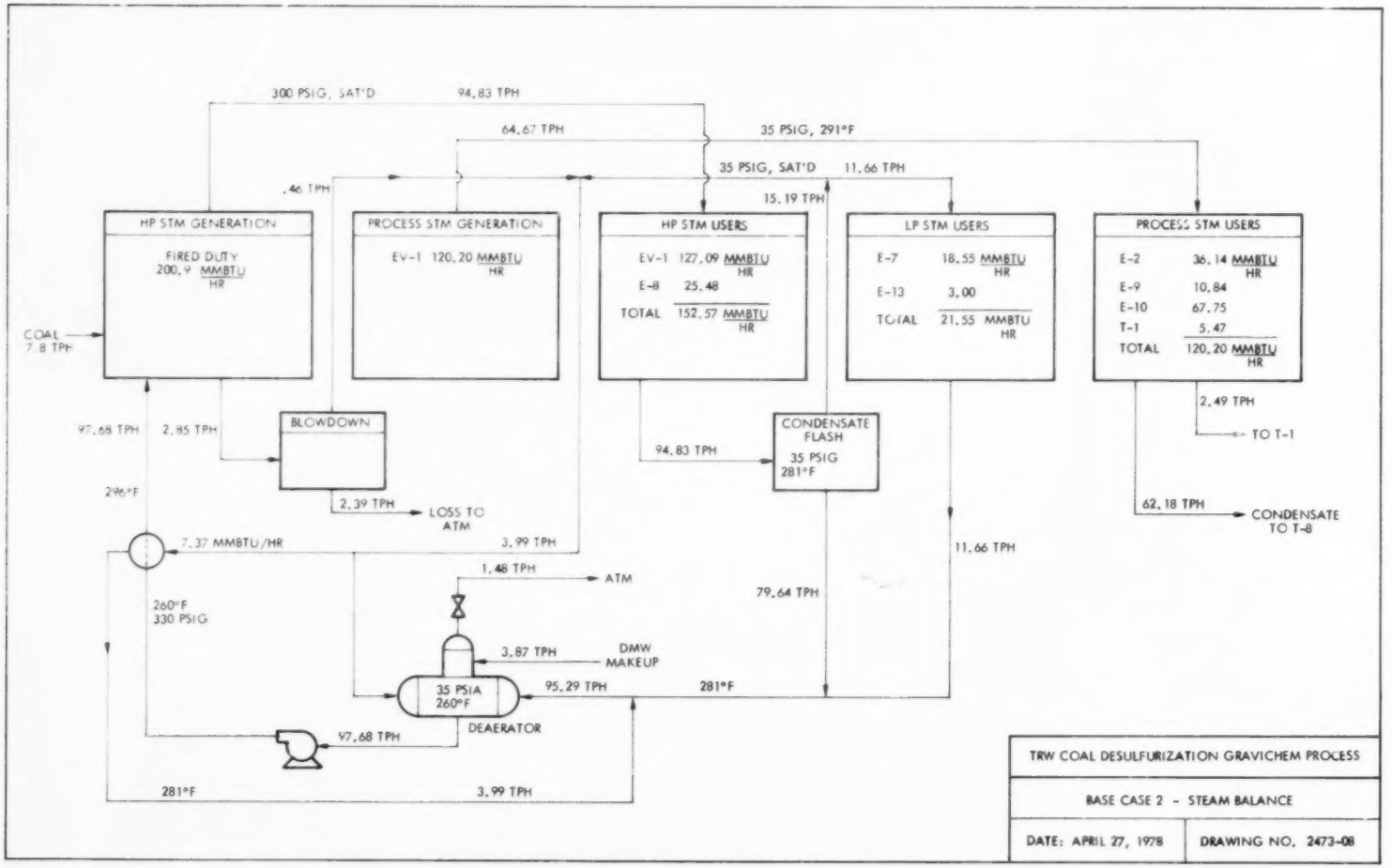

Figure C-5. TRW Coal Desulfurization Gravichem Process - Base Case 2 - Steam Balance

TABLE C-2. BASE CASE 2 - KENTUCKY NO. 9 COAL MATERIAL BALANCE

Stream	1	2	3	4	5	6	7	8	9	10	11
Description	Coal Feed	Recycled Leach Solution	Heating Steam	Mixer Slurry	Float Coal Slurry	Sink Coal Slurry	Reactor Effluent Slurry	Reactor Pumparound	Oxygen	R-1 Oxygen Feed	R-2 Oxygen Feed
Water	22.22	386.92	9.62	417.28	279.73	137.41	138.29	43.63			
$FeSO_4$		12.25		38.96	27.74	13.62	2.37	.75			
$Fe_2(SO_4)_3$		144.99		113.29	74.07	36.38	59.29	18.70			
H_2SO_4		24.00		32.11	22.02	10.82	6.00	1.89			
Coal	191.01			191.01	98.12	92.89	92.89	29.30			
Pyrite	8.99			6.92	.93	5.81	.95	.30			
Sulfur				.44	.07	.41	1.45	.46			
Oxygen									4.81	3.90	.91
Nitrogen											
Acetone											
Lime											
Gypsum											
Total, TPH	222.22	568.16	9.62	800.01	502.68	297.34	301.24	95.03	4.81	3.90	.91
T, °F	75	215	234	215	176	176	250	250	75	75	75
P, PSIG	0	0	1	35	15	45	35	50	50	50	50

(Continued)

TABLE C-2 (Continued)

Stream	12	13	14	15	16	17	18	19	20	21
Description	Flash Steam	F-3 Feed Slurry	LP Steam To T-1	F-1 Filtrate	F-1 Wash Filtrate	F-3 Wash Filtrate	Evaporator Feed	Evaporator Bottoms	[illegible]	[illegible]
Water	6.68	131.61	2.94	230.18	99.12	35.26	134.38	99.77	5.61	94.16
$FeSO_4$		2.37		22.82	4.91	.41	5.32	5.32		
$Fe_2(SO_4)_3$		59.29		60.94	13.11	10.21	23.32	23.32		
H_2SO_4		6.00		18.12	3.90	1.03	4.93	4.93		
Coal		92.89								
Pyrite		.95								
Sulfur		1.45								
Oxygen										
Nitrogen										
Acetone										
Lime										
Gypsum										
Total, TPH	6.68	294.56	2.94	332.06	121.04	46.91	167.95	133.34	5.61	94.16
T, °F	219	219	290	160	160	160	160	219	219	219
P, PSIG	2.3	20	35	65	65	65	5	20	35	65

(Continued)

TABLE C-2. (Continued)

Stream	22	23	24	25	26	27	28	29	30	31	32
Description	F-5 Filter Cake	Wash Water	F-5 Wash Water	F-3 Wash Water	Pond Water Return	Makeup Wash Water	Recovered LP Condensate	H_2SO_4 Makeup	F-3 Filtrate	Regen. Effluent	Leach Solution Recycle
Water	49.56	165.83	99.12	66.71	78.04	26.31	55.90	.06	83.97	233.19	386.93
$FeSO_4$	.004								1.51	5.42	12.25
$Fe_2(SO_4)_3$	.01								37.83	83.84	144.99
H_2SO_4	.003							2.74	3.83	12.51	24.01
Coal	98.12										
Pyrite	.93										
Sulfur	.07										
Oxygen											
Nitrogen											
Acetone											
Lime											
Gypsum											
Total, TPH	148.69	165.83	99.12	66.71	78.04	26.31	55.90	2.80	127.14	334.96	568.18
T, °F	160	160	160	160	75	75	281	75	160	250	216
P, PSIG	0	20	5	5	20	20	35	35	35	35	0

(Continued)

TABLE C-2. (Continued)

Stream	33	34	35	36	37	38	39	40	41	42	43
Description	CW To E-1	LP STM FM EV-1 To E-2	HP STM To EV-1	LP STM To E-13	F-3 Filter Cake	Acetone/ Coal Slurry	Acetone To T-11	Acetone To F-4	F-4 Filter Cake	F-4 Filtrate	Stripper Overhead
Water	773	19.45	79.0	1.62	47.65	47.65			1.27	46.38	
$FeSO_4$					.09	.09			.002	.084	
$Fe_2(SO_4)_3$					2.15	2.15			.06	2.09	
H_2SO_4					.22	.22			<.01	.21	
Coal					92.89	92.89			92.89		
Pyrite					.95	.95			.95		
Sulfur					1.45	1.45			.20	1.25	
Oxygen											
Nitrogen											
Acetone						95.29	95.29	40.00	36.84	98.45	98.45
Lime											
Gypsum											
Total, TPH	773	19.45	79.0	1.62	145.40	240.69	95.29	40.00	132.22	148.46	98.45
T, °F	77	291	422	281	160	85	85	85	85	85	85
P, PSIG	50	35	300	35	0	10	0	0	0	25	15

(Continued)

TABLE C-2. (Continued)

Stream	44	45	46	47	48	49	50	51	52
Description	Stripper Bottoms	Sulfur Byproduct	Stripper Bottoms To Neutralizer	F-3 Wash Filtrate To Neutralizer	Neutralizer Lime Feed	Gypsum To Pond	Dried Coal	Combined Coal Product	Acetone Condensate
Water	46.38		46.38	31.45		78.04		49.56	
$FeSO_4$	.084		.08	.36			.002	.006	
$Fe_2(SO_4)_3$	2.09		2.09	9.11			.06	.07	
H_2SO_4	.21		.21	.92			<.01	.01	
Coal							92.89	191.01	
Pyrite							.95	1.88	
Sulfur	1.25	1.25					.20	.27	
Oxygen									
Nitrogen							.53	.53	
Acetone							.1	.10	36.74
Lime					5.52				
Gypsum						18.08			
Total, TPH	50.01	1.25	48.76	41.84	5.52	96.12	94.74	243.44	36.74
T, °F	250	250	250	160	75	160	225	190	85
P, PSIG	15	15	15	0	-	10	0	0	25

(Continued)

TABLE C-2. (Continued)

Stream	53	54	55	56	57	58	59	60	61	62
Description	Acetone Makeup	Nitrogen Makeup	Pond Water To Scrubber	CW To E-5	CW To E-12	CW To E-11	CW To E-6	LP STM To E-10	HP STM To E-8	LP STM To E-7
Water			25	197.0	146.0	860.0	880.0	36.45	15.83	10.04
$FeSO_4$										
$Fe_2(SO_4)_3$										
H_2SO_4										
Coal										
Pyrite										
Sulfur										
Oxygen										
Nitrogen		.53								
Acetone	.1									
Lime										
Gypsum										
Total, TPH	.1	.53	25	197.0	146.0	860.0	880.0	36.45	15.83	10.04
T, °F	85	77	75	77	77	77	77	291	422	281
P, PSIG	25	20	15	50	50	50	50	35	300	35

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
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4. TITLE AND SUBTITLE Reactor Test Project for Chemical Removal of Pyritic Sulfur from Coal: Volume II. Appendices		5. REPORT DATE January 1979 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) R. A. Meyers, M. J. Santy, W. D. Hart, L. C. McClanathan, and R. A. Orsini		8. PERFORMING ORGANIZATION REPORT NO.
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15. SUPPLEMENTARY NOTES IERL-RTP project officer is Lewis D. Tamny, Mail Drop 61, 919/2709.		

16. ABSTRACT The report gives results of an evaluation of the initial performance of the Reactor Test Unit (RTU) for chemical removal of pyritic sulfur from an Appalachian coal. Operation of the plant--from its checkout and shakedown in September 1977 through January 1978--demonstrated that the RTU could be run continuously in three-shift operation to reduce the coal from 2.4 lb SO_2/million Btu to a level of 1.0 to 1.2 lb SO_2/million Btu, after rinsing and extraction of generated elemental sulfur. There was no measurable coal oxidation during processing and leach rates in the plant were greatly improved over bench-scale values. The leach solution/coal/oxygen environment was found to be corrosive to the installed stainless steel reactor, necessitating future upgrading to support additional testing. Bench-scale experiments showed that the leach solution can be used as a homogeneous dense-media to efficiently gravity-separate coal prior to processing. Beneficial engineering cost improvements are obtained based on using this approach, resulting in capital cost estimates of $68-69/kW and with $0.44-0.50/million Btu processing costs, including amortization of capital, for input coal costing $0.78-0.81/million Btu. Overall energy efficiency was 93-96%.

17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution Coal Desulfurization Pyrite Chemical Cleaning Rinsing Extraction	Pollution Control Stationary Sources Pyritic Sulfur	13B 08G, 21D 07A, 07D 13H
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